Test Report

AIR-CAP3502P-A-K9
Cisco Aironet 802.11n Dual Band Access Points

FCC ID: LDK102073P

IC: 2461B-102073P

(Also covers AIR-CAP3502P-N-K9, AIR-CAP3502P-T-K9)

5725-5850 MHz

Against the following Specifications:

CFR47 Part 15.247

RSS210

Cisco Systems

170 West Tasman Drive

San Jose, CA 95134

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Section 1: Overview

1.1 Test Summary

samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Emission	Immunity
CFR47 Part 15.247 RSS210	N/A

The specifications listed above represent actual tests performed to demonstrate compliance against the specifications and basic standards listed on the front cover of this report. This list is not a one to one match to the front cover for one or more of the following reasons.

1. Basic standards call up many different test phenomena specifications such as the 61000-4-X series. The basic standards define which elements and levels shall be applied from these specifications and as such it is not appropriate to list the individual specifications on the front cover.
2. A Standard listed on the front cover may be required in a particular country but is not appropriate for the particular technologies included in the equipment under test. E.g. You cannot test a DC product to the mains Harmonics requirements in EN61000-3-2. See section 3.2.
3. Test results against a particular standard or specification may be included in a different test report. See section 3.2 for an EDCS reference of this data.
4. Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
5. Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.
6. Testing may have been performed to an equivalent test that satisfies the requirements of the standards and specifications listed on the front cover of the report. See section 3.2.
7. Where radiated emissions testing has been performed to EN55022/CISPR22 the additional requirements of VCCI: V- 3/2006.04, EN55022: 1994 +A1/2 and CAN/CSA- CISPR 22-02 have also been evaluated unless otherwise stated.
8. Testing to the requirements of CFR47 Part 15 was performed against the CISPR22 limits. The results are therefore deemed satisfactory evidence of compliance with Industry Canada Interference Causing Equipment Standard ICES-003.
9. Where assessment has been performed to CISPR24, all the applicable test requirements may have not been covered. Refer to the results section for the tests performed.

Notes:

1) Where a specification listed on the front cover of this report has deviations from the basic standards listed above, the additional technical requirements of the specification were also assessed.
2) Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
3) Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.

Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

*[Where applicable] For ESD testing the humidity limits used were 30% to 60% and for EFT/B tests the humidity limits used were 25% to 75%.

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)
220V 50 Hz (+/-20%)

2.2 Date of start of testing

13-July-2010

2.3 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.4 Testing facilities

This assessment was performed by:

Testing Laboratory

Cisco Systems, Inc.,	Cisco Systems, Inc.
4125 Highlander Parkway	170 West Tasman Drive
Richfield, OH 44286	San Jose, CA 95134
USA	USA

Test Engineers

James Nicholson

2.5 Equipment Assessed (EUT)

AIR-CAP3502P-A-K9 Cisco Aironet 802.11n Dual Band Access Point

2.6 EUT Description

The AIR-CAP3502P-A-K9 Cisco Aironet 802.11n Dual Band Access Points requires professional installation, and supports the following modes of operation. The modes are further defined in the radio Theory of Operation. The modes included in this report represent the worst case data for all modes.

Legacy OFDM, Non HT-20, Single Antenna, 6 to 54 Mbps
Legacy OFDM, Non HT-20, Dual Antennas, 6 to 54 Mbps
Legacy OFDM , Non HT-20 Dual Antennas with Beam Forming, 6 to 54 Mbps
HT-20, Single Antenna, M0 to M7
HT-20, Dual Antennas, M0 to M15
Non HT-40 Duplicate, Single Antenna, 6-54 Mbps
Non HT-40 Duplicate, Dual Antennas, 6-54 Mbps
HT-40, Single Antenna, M0 to M7
HT-40, Dual Antennas, M0 to M15

The following antennas are supported by this product series. The items in bold will be specifically tested and cover all others. The data included in this report represent the worst case data for all antennas.

Frequency	Part Number	Antenna Type	Antenna Gain (dBi)
2.4 GHz	AIR-ANT2422DB-R	Articulating black dipole	2
	AIR-ANT4941	Articulating black dipole	2
	AIR-ANT2422DG-R	Non-articulating gray dipole	2
	AIR-ANT2422DW-R	Articulating white dipole	2
	AIR-ANT2422SDW-R	Stubby monopole	3
	AIR-ANT2430V-R	3-elementMIMO ceiling mount omni	3
	AIR-ANT2440NV-R	3-element MIMO wall/mast mount omni	4
	AIR-ANT1728	indoor omni	5
	AIR-ANT2450S-R	Sector	5
	AIR-ANT2506	Outdoor omni	5
	AIR-ANT2460P-R	Patch	6
	AIR-ANT2460NP-R	3-element MIMO patch	6
	AIR-ANT2485P-R	Patch	8.5
	AIR-ANT2410Y-R	Yagi	10
	AIR-ANT1949	Yagi	13.5
5 GHz	AIR-ANT5135D-R	Articulating dipole	3.5
	AIR-ANT5135DB-R	Articulating dipole	3.5
	AIR-ANT5135DG-R	Non-articulating gray dipole	3.5
	AIR-ANT5135DW-R	Articulating white dipole	3.5
	AIR-ANT5135SDW-R	Stubby monopole	3.5
	AIR-ANT5140V-R	3-element MIMO ceiling mount omni	4
	AIR-ANT5160V-R	Omni-Directional	6
	AIR-ANT5160NP-R	3-element MIMO patch antenna	6
2.4/5 GHz	AIR-ANT2451NV-R	MIMO 6-Element Dual Band Omni	2.5 / 3.5
	AIR-ANT25137NP-R	**Patch**	**13/7**

Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the “Justification for worst Case test Configuration” section of this report for further details on the selection of EUT samples.

4.1 Sample Details (Photographs of the test samples, where appropriate can be found in appendix H)

Sample No.	Equipment Details	Part Number	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01	AIR-CAP3502P-A-K9		Cisco Systems	NA	NA	NA	
S02	AIR-PWR-B	341-0306-01	Cisco Systems	NA	NA	NA	
S05	AIR-ANT5160V-R						
S06	AIR-ANT25137NP-R						

4.2 System Details

System #	Description	Samples
1	EUT	S01, S02

4.3 Mode of Operation Details

Mode#	Description	Comments
1	Continuous Transmitting	Continuous Transmitting

Appendix A: Emission Test Results

Testing Laboratory: Cisco Systems, Inc., 4125 Highlander Parkway, Richfield, OH, USA

Average Output Power

Connect the antenna(s) to the power meter at the average power sensor input. Configure the power meter to measure average power for the transmitter frequencies listed below (enter all losses between the transmitter output and the power meter).

Place the radio in continuous transmit mode and record the reading on the power meter.

Frequency	Mode	Data Rate	Target Power Level			Actual Power Level
			Tx A	Tx B	Total	Total
5745	Non HT-20 Beam Forming	54	17	17	20	**19.7**
5785	Non HT-20 Beam Forming	54	17	17	20	**19.7**
5825	Non HT-20 Beam Forming	54	17	17	20	**19.7**
5745/5765	Non HT-40 Duplicate	54	17	17	20	**19.9**
5745/5765	HT-40	M7	17	17	20	**19.7**
5785/5805	Non HT-40 Duplicate	54	17	17	20	**19.9**
5785/5805	HT-40	M7	17	17	20	**20.1**

6dB Bandwidth

15.247: Systems using digital modulation techniques may operate in the 5725-5850MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.

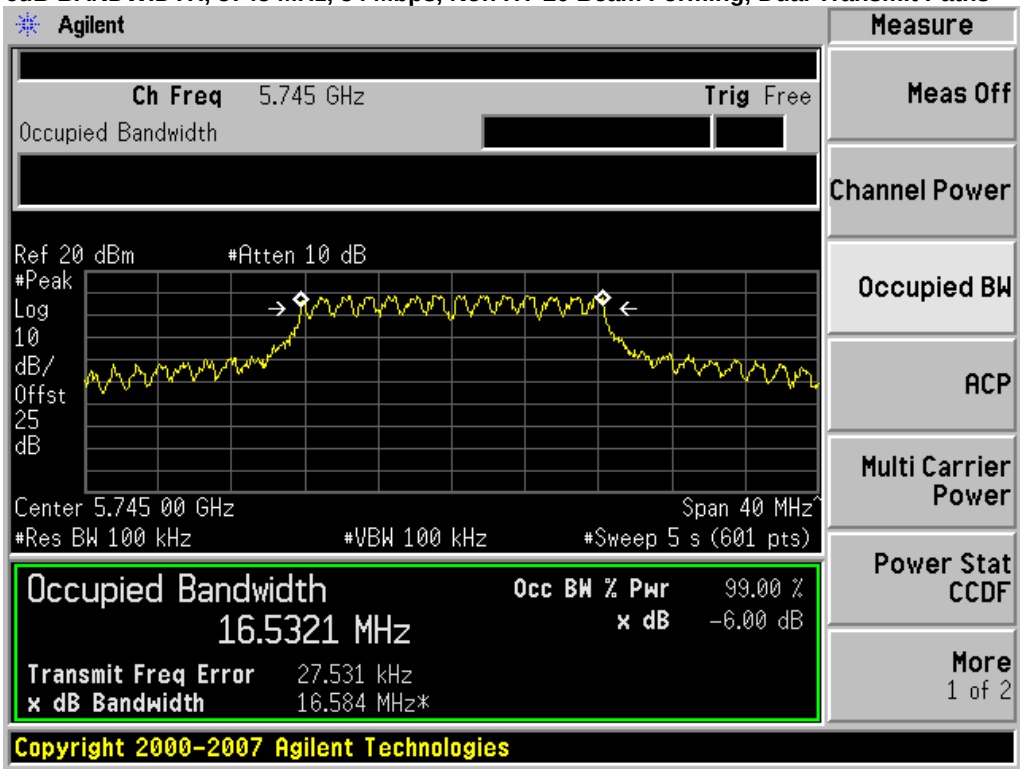
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

Center Frequency:	Frequency from table below
Span:	2 x Nominal Bandwidth (e.g. 40MHz for a 20MHz channel)
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5 s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	100 kHz
X dB Bandwidth: 6 dB	
Detector:	Peak
Trace:	Single

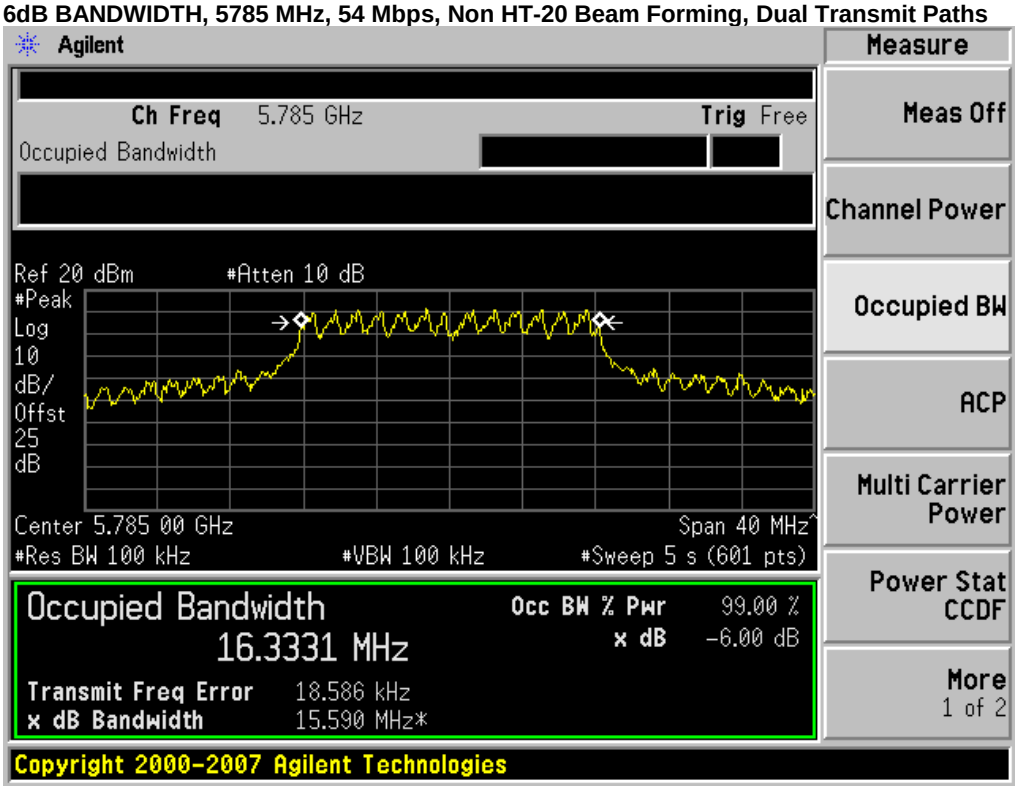
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	Mode	Data Rate (Mbps)	6dB BW (MHz)	Limit (kHz)	Margin (MHz)
5745	Non HT-20 Beam Forming	54	**16.6**	>500	16.1
5785	Non HT-20 Beam Forming	54	**15.6**	>500	15.1
5825	Non HT-20 Beam Forming	54	**15.6**	>500	15.1
5745/5765	Non HT-40 Duplicate	54	**35.3**	>500	34.8
5745/5765	HT-40	M7	**32.9**	>500	32.4
5785/5805	Non HT-40 Duplicate	54	**35.2**	>500	34.7
5785/5805	HT-40	M7	**35.7**	>500	35.2

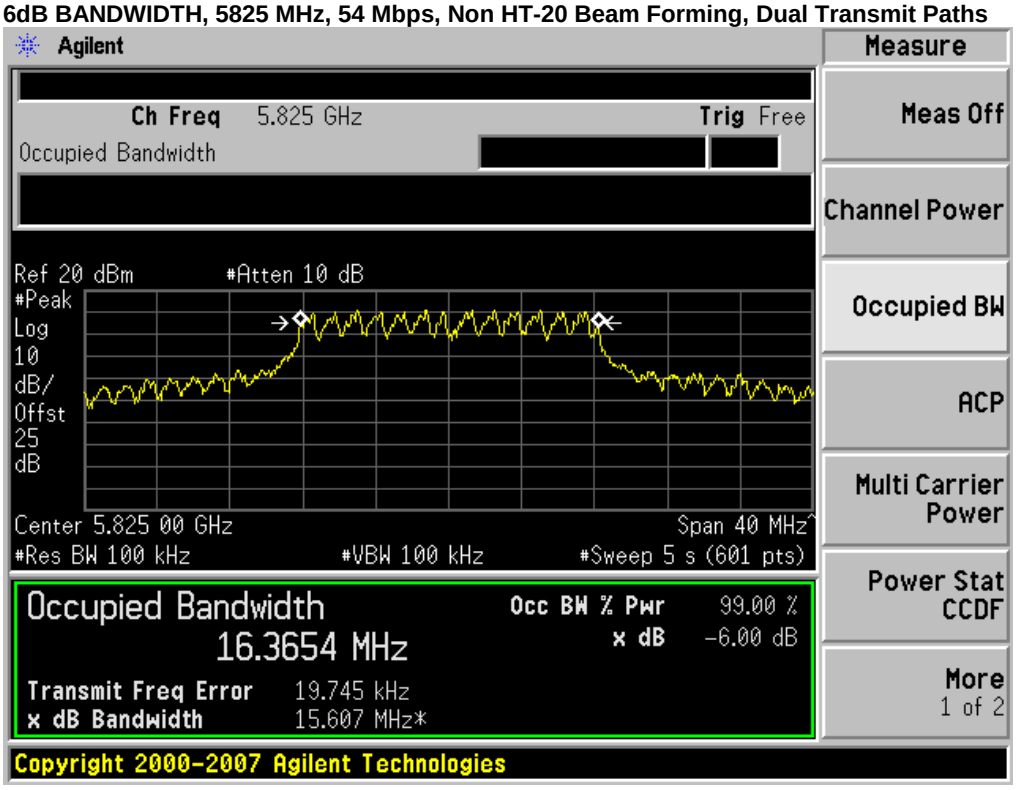
6dB BANDWIDTH, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



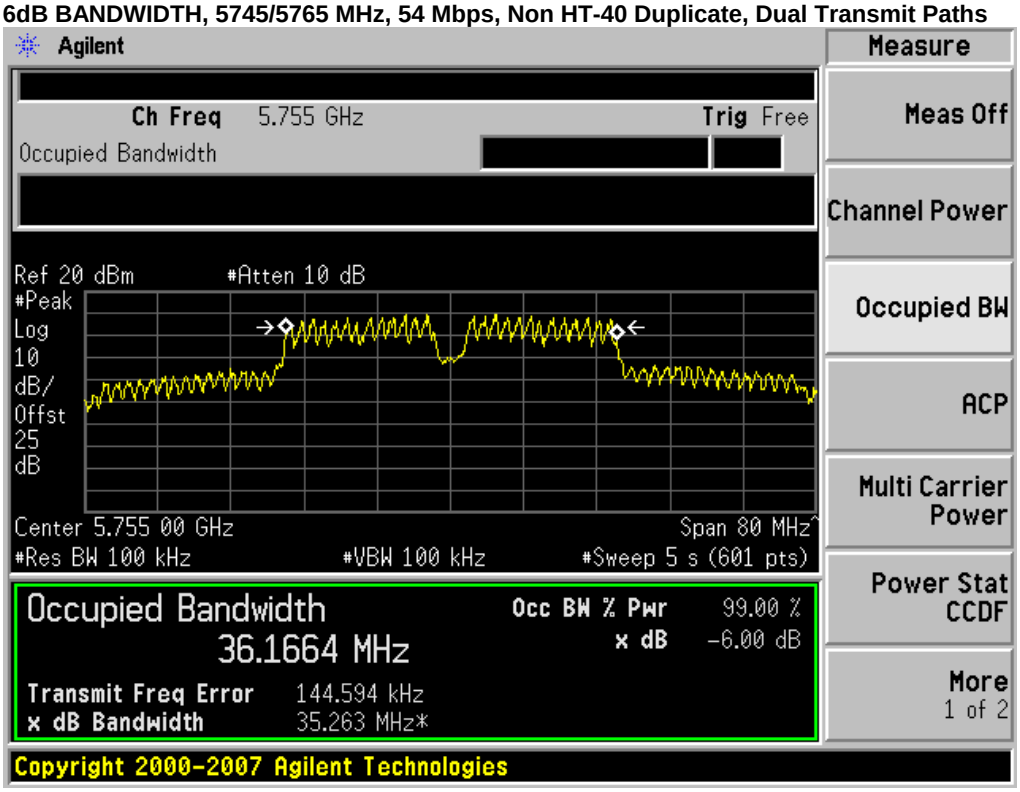
6dB BANDWIDTH, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



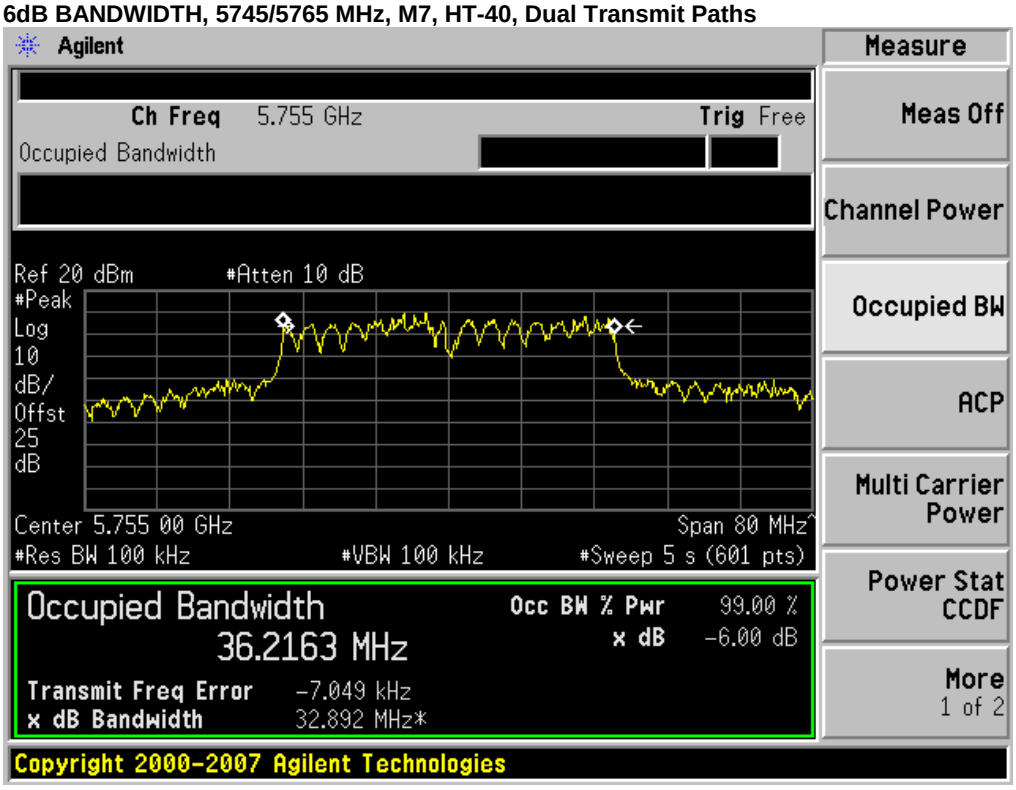
6dB BANDWIDTH, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



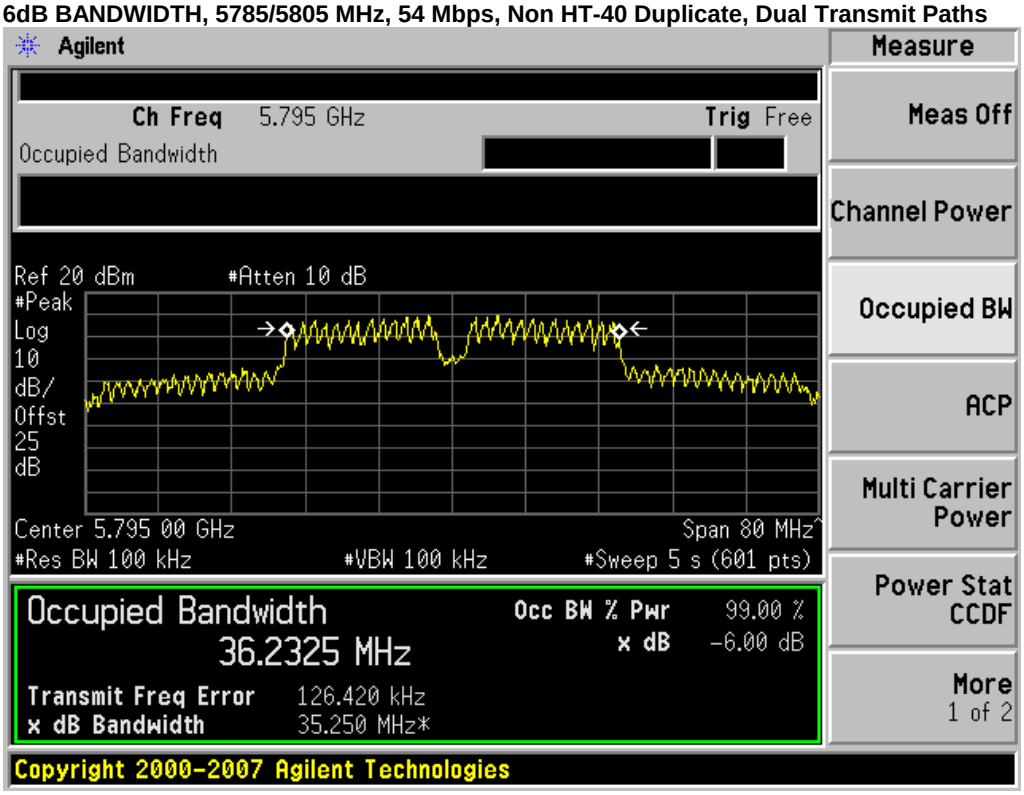
6dB BANDWIDTH, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



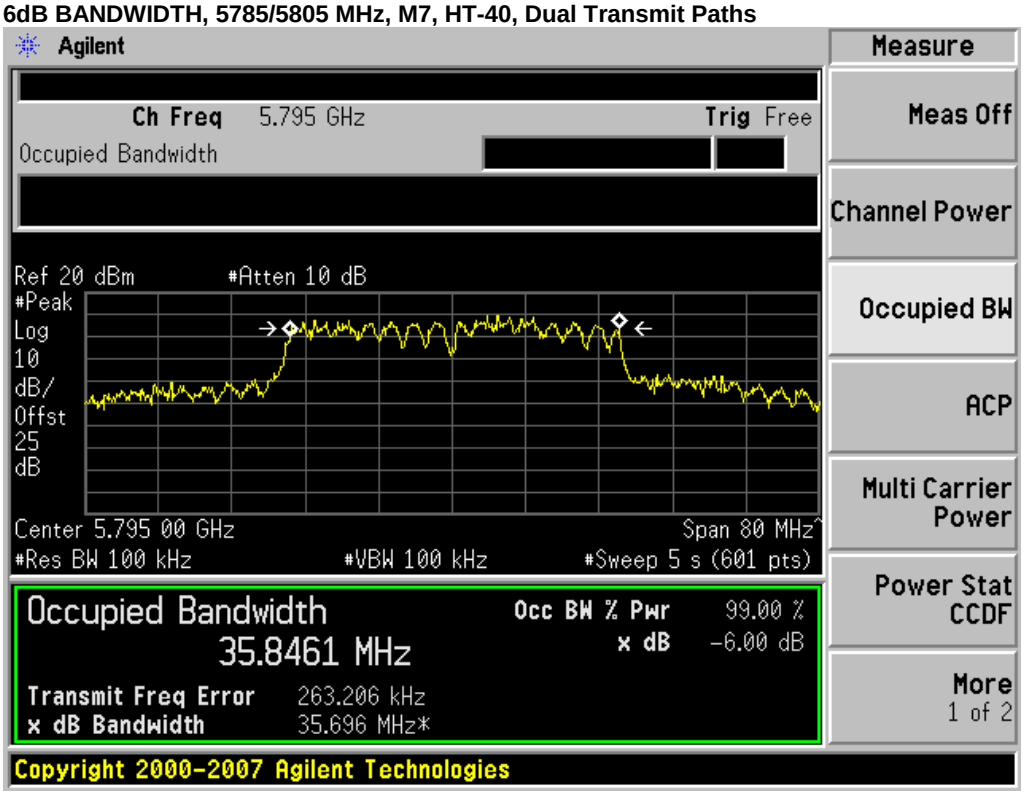
6dB BANDWIDTH, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths



6dB BANDWIDTH, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



6dB BANDWIDTH, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths



99% and 26dB Bandwidth

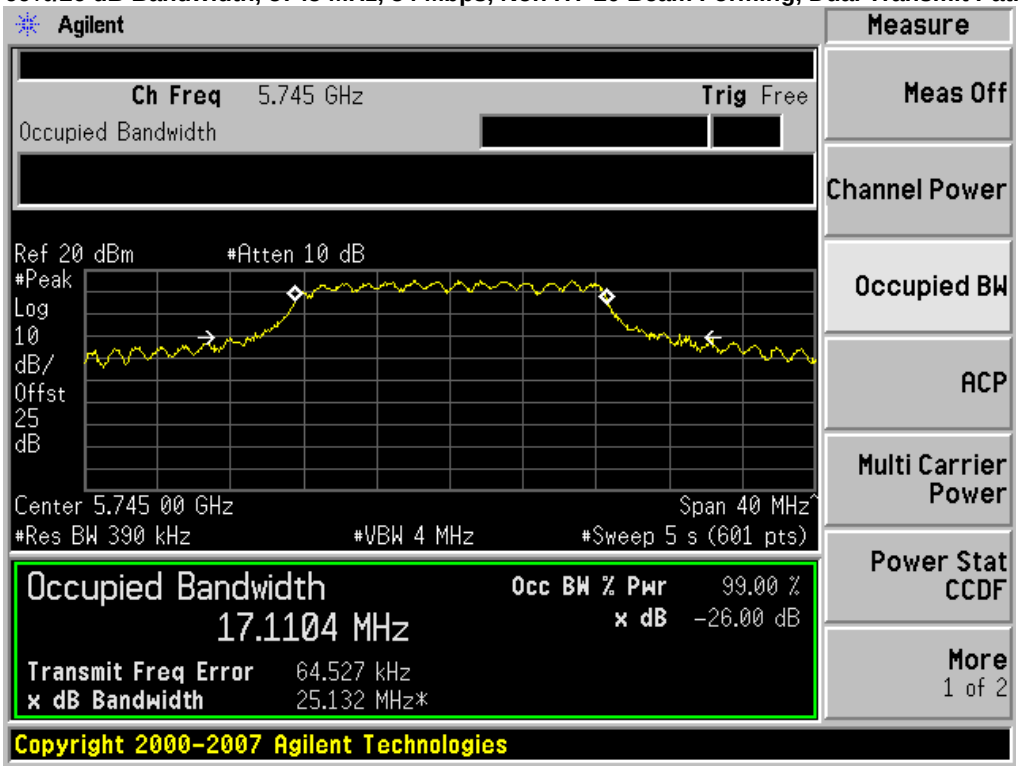
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

Center Frequency: Frequency from table below
Span: 2 x Nominal Bandwidth (e.g. 40MHz for a 20MHz channel)
Reference Level: 20 dBm
Attenuation: 10 dB
Sweep Time: 5 s
Resolution Bandwidth: 1%-3% of 26 dB Bandwidth
Video Bandwidth: ≥Resolution Bandwidth
X dB Bandwidth: 26 dB
Detector: Peak
Trace: Single

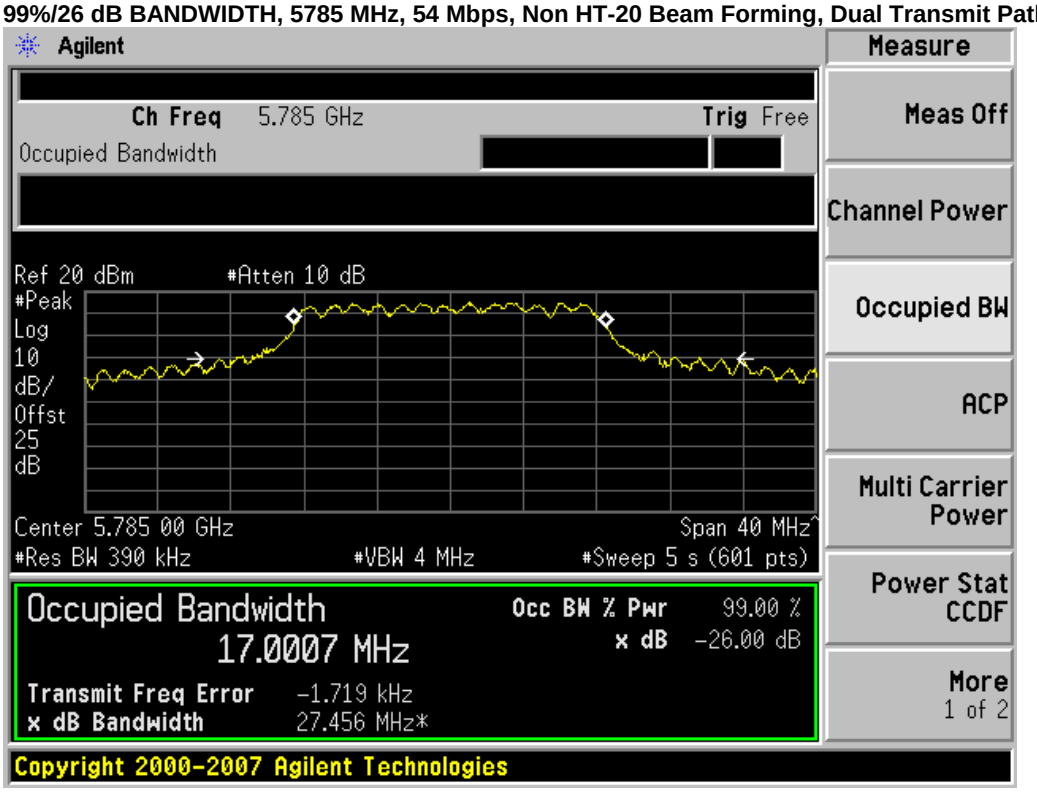
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	Mode	Data Rate (Mbps)	26dB BW (MHz)	99% BW (MHz)
5745	Non HT-20 Beam Forming	54	**25.1**	**17.1**
5785	Non HT-20 Beam Forming	54	**27.5**	**17.0**
5825	Non HT-20 Beam Forming	54	**29.1**	**17.0**
5745/5765	Non HT-40 Duplicate	54	**70.7**	**41.3**
5745/5765	HT-40	M7	**60.2**	**36.8**
5785/5805	Non HT-40 Duplicate	54	**74.6**	**41.4**
5785/5805	HT-40	M7	**57.0**	**36.5**

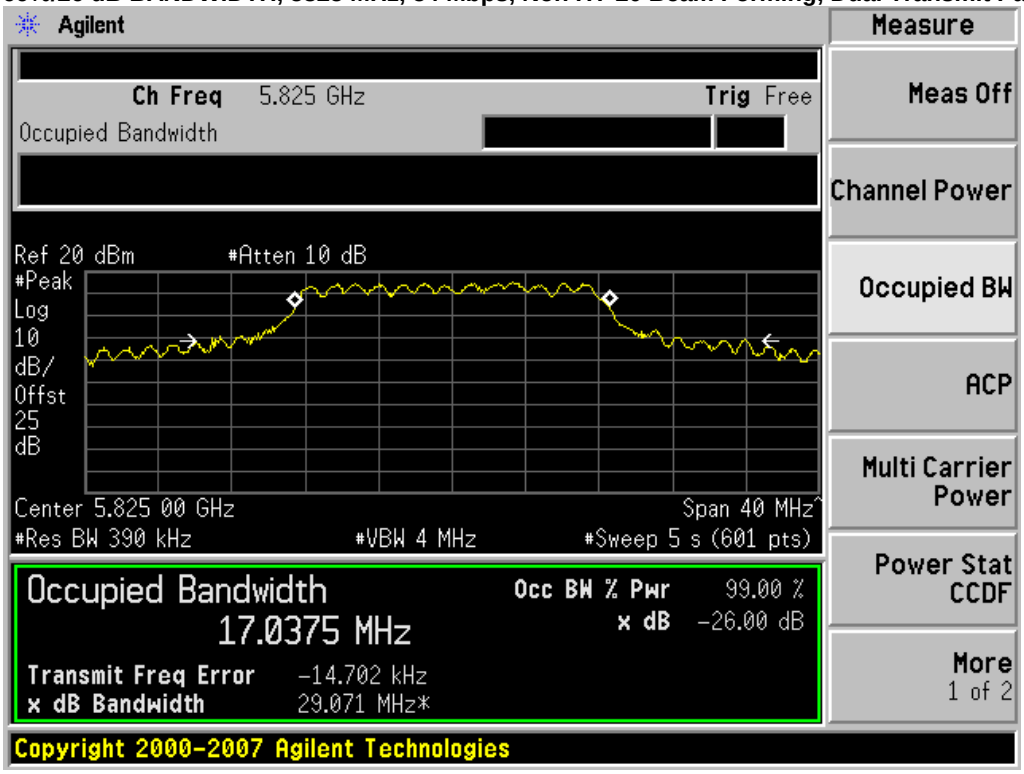
99%/26 dB Bandwidth, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



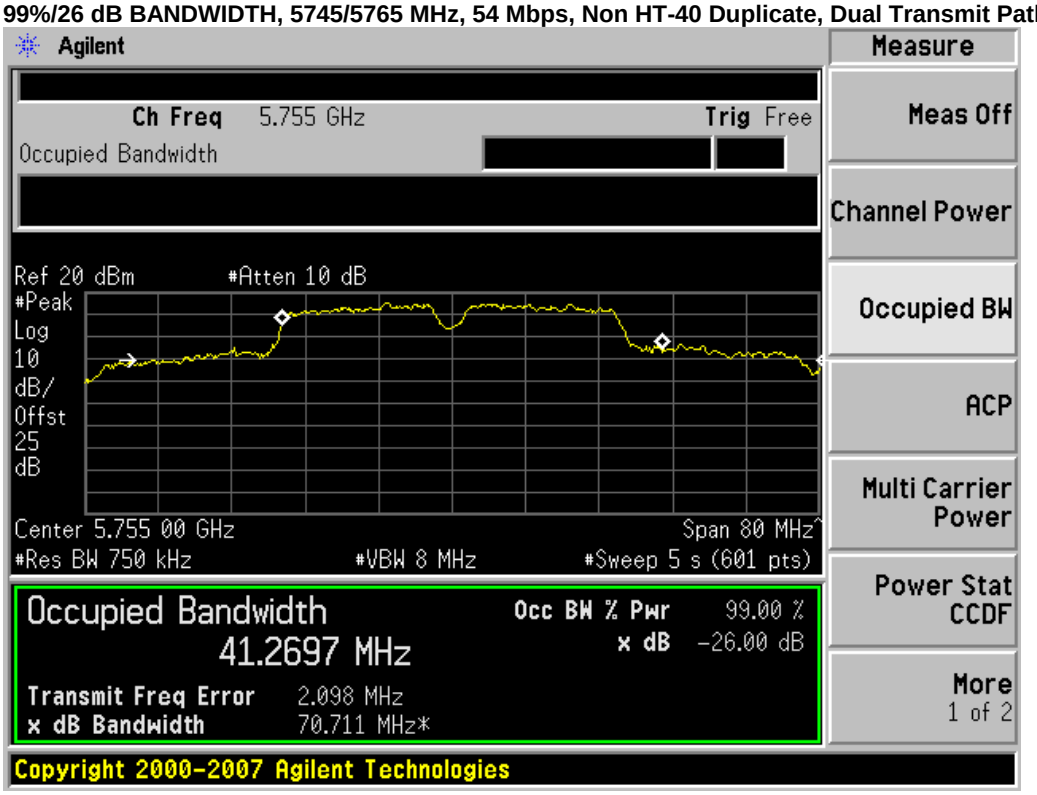
99%/26 dB BANDWIDTH, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



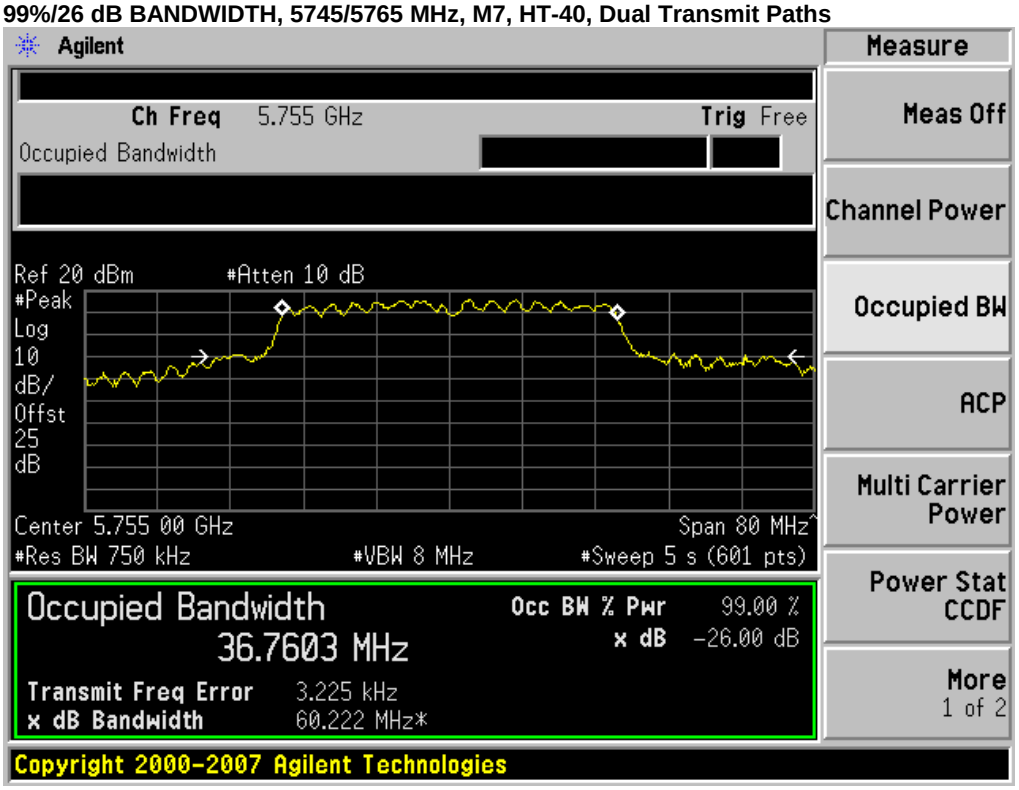
99%/26 dB BANDWIDTH, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



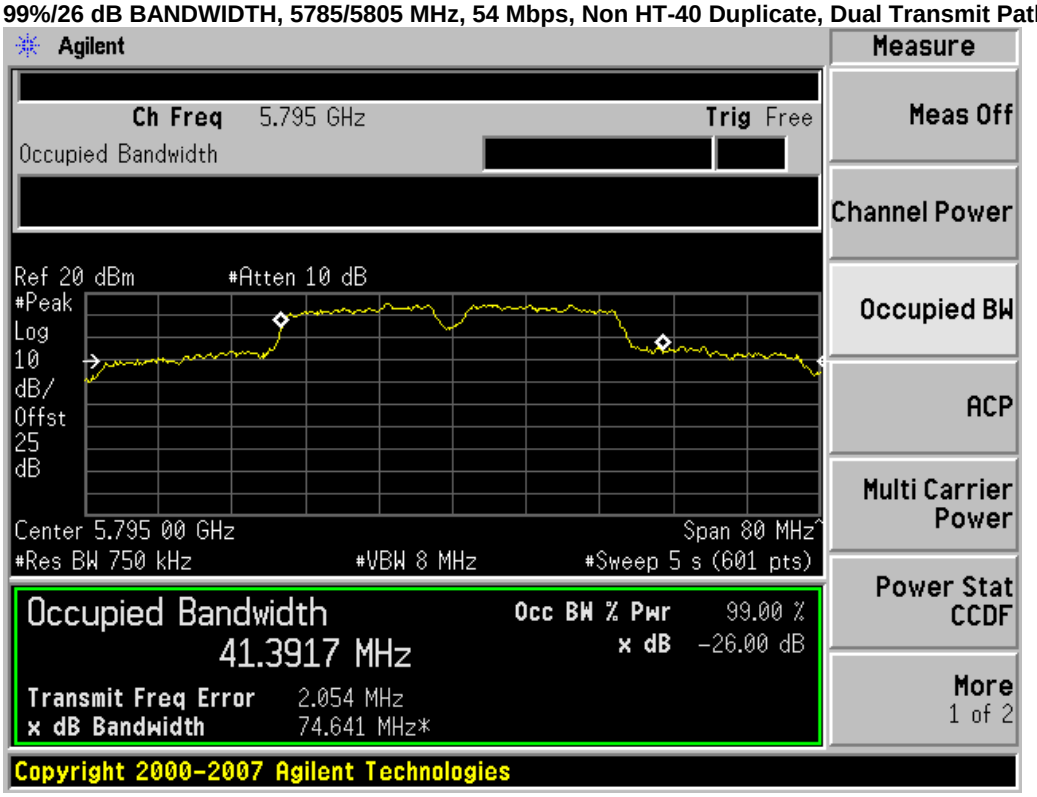
99%/26 dB BANDWIDTH, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



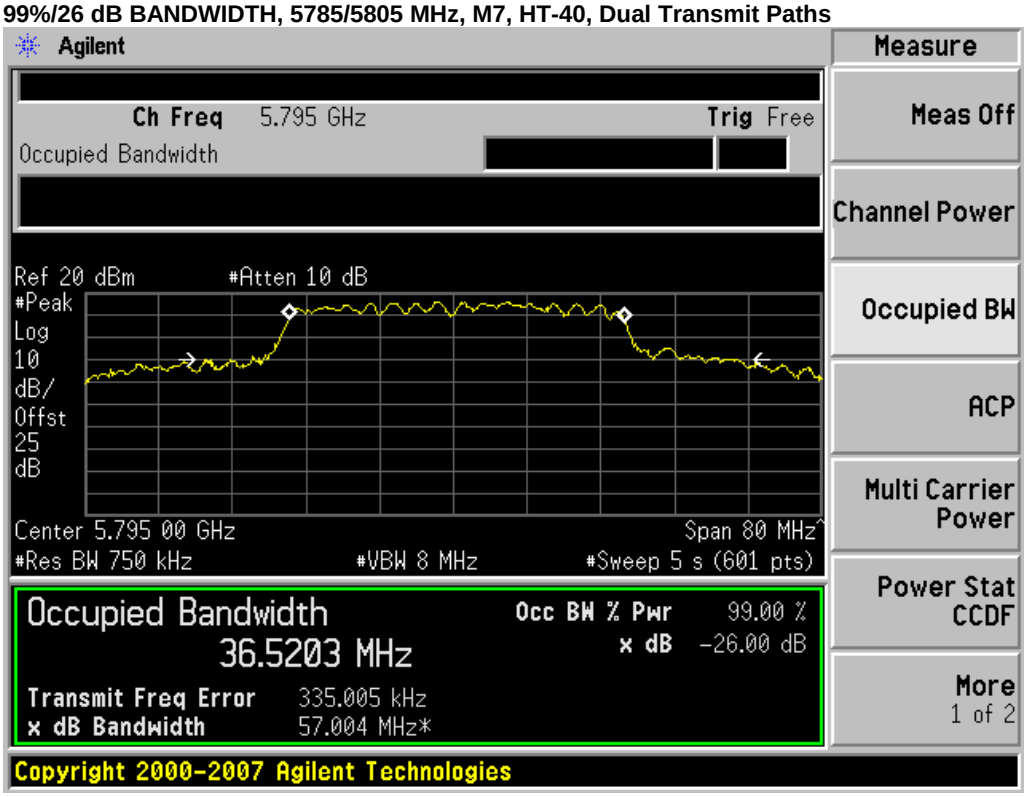
99%/26 dB BANDWIDTH, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths



99%/26 dB BANDWIDTH, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



99%/26 dB BANDWIDTH, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths



Peak Output Power

15.247: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 5725-5850MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum supported antenna gain for all bands is 7dBi. In beamforming mode, the 6dBi behaves as 7dBi+10log(n) (n=2 radiating elements) = 10dBi. Therefore the maximum allowable output power requires 4dB reduction in beam forming mode, and 1 dB reduction in all other modes.

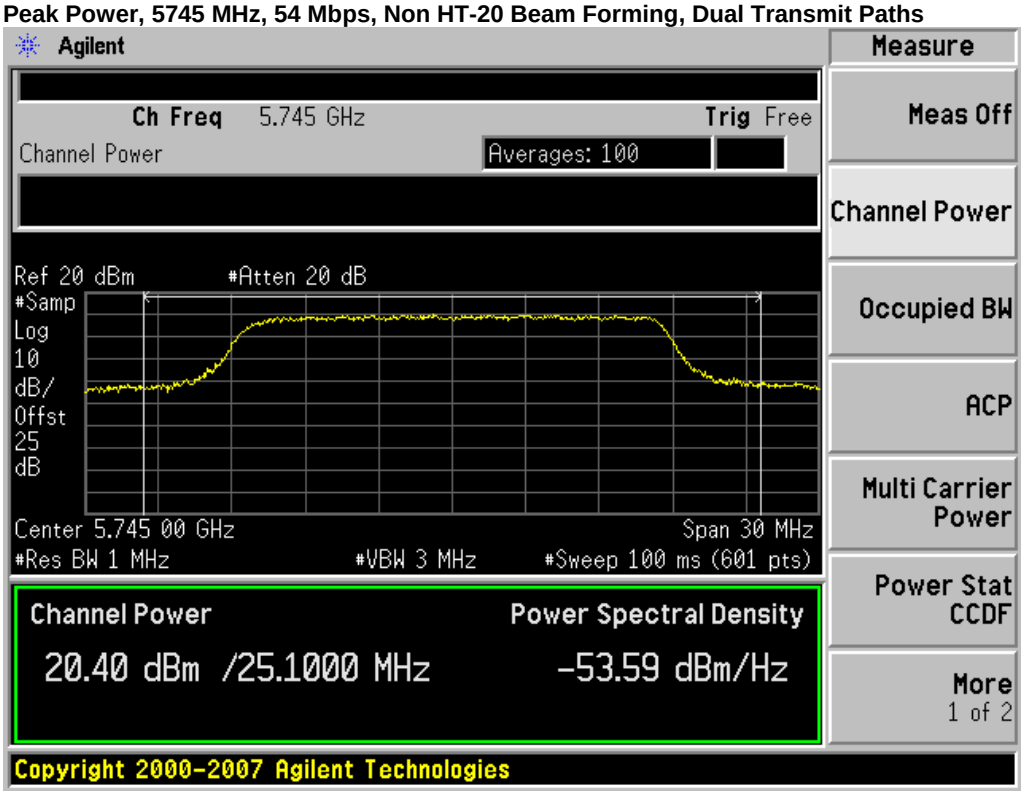
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

Enable "Channel Power" function of analyzer
Center Frequency: Frequency from table below
Span: 20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset: Correct for attenuator and cable loss.
Reference Level: 20 dBm
Attenuation: 20 dB
Sweep Time: 100ms, Single sweep
Resolution Bandwidth: 1 MHz
Video Bandwidth: 3 MHz
Detector: Sample
Trace: Trace Average 100 traces in Power Averaging Mode
Integration BW: =26 dB BW from 26 dB Bandwidth Data

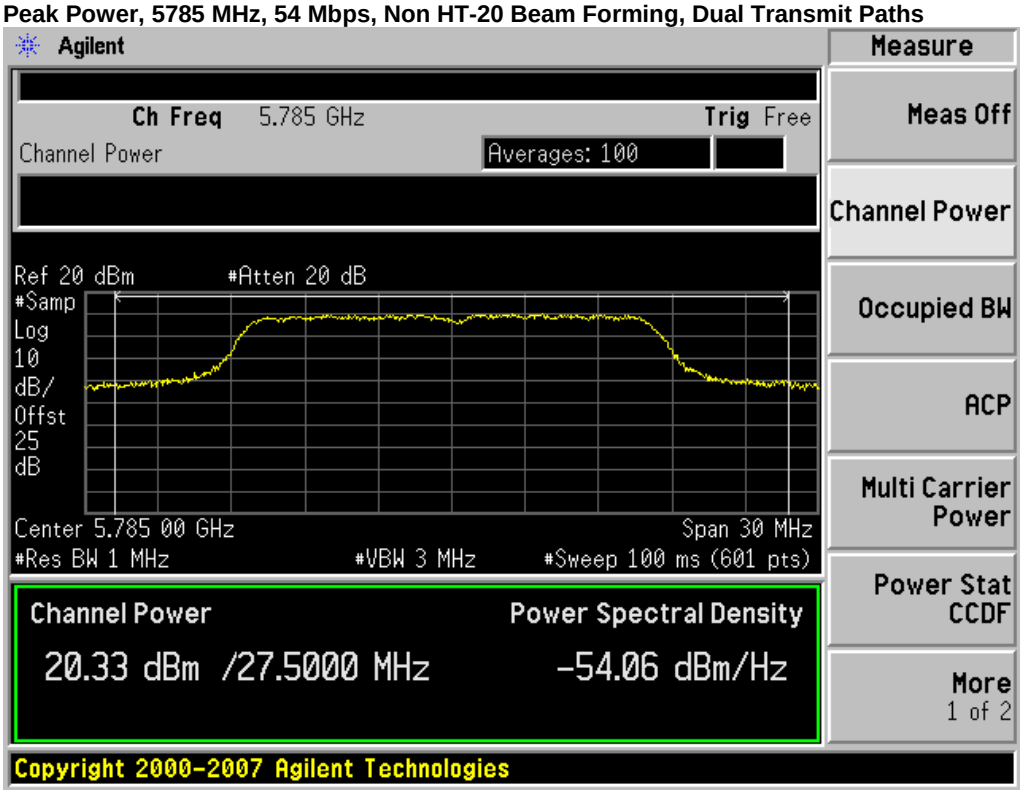
After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power.

Frequency (MHz)	Mode	Data Rate (Mbps)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
5745	Non HT-20 Beam Forming	54	**20.4**	26	5.598
5785	Non HT-20 Beam Forming	54	**20.3**	26	5.665
5825	Non HT-20 Beam Forming	54	**20.4**	26	5.575
5745/5765	Non HT-40 Duplicate	54	**20.4**	29	8.552
5745/5765	HT-40	M7	**20.0**	29	8.982
5785/5805	Non HT-40 Duplicate	54	**20.4**	29	8.628
5785/5805	HT-40	M7	**20.7**	29	8.325

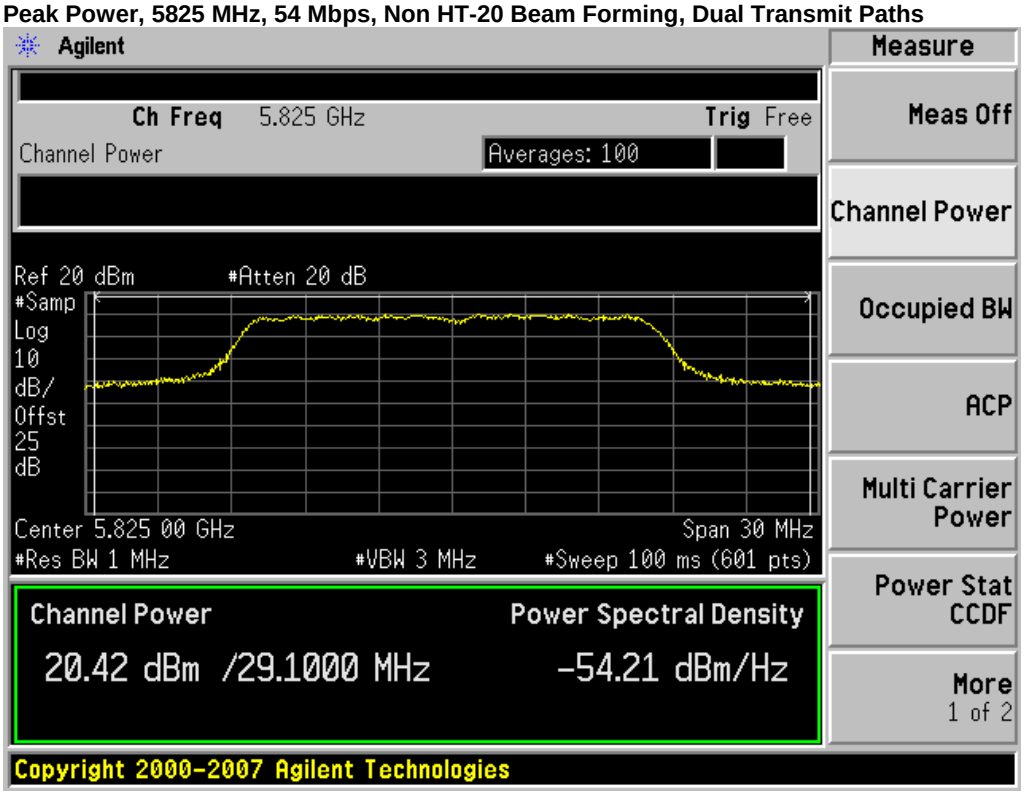
Peak Power, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



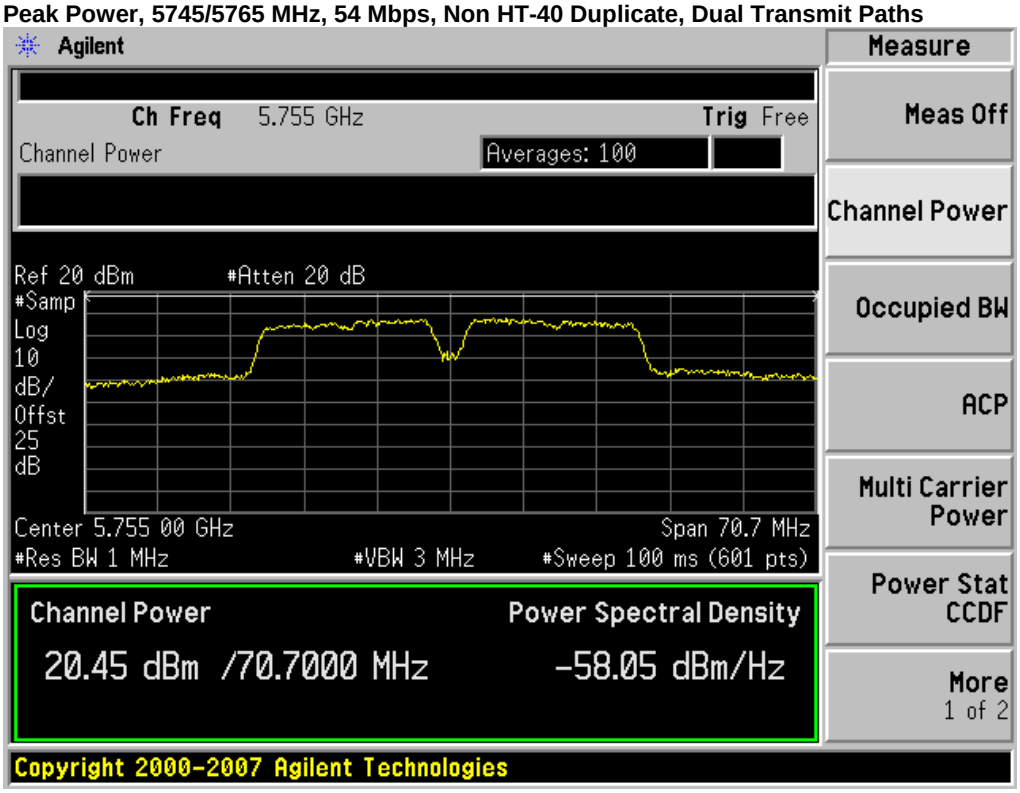
Peak Power, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



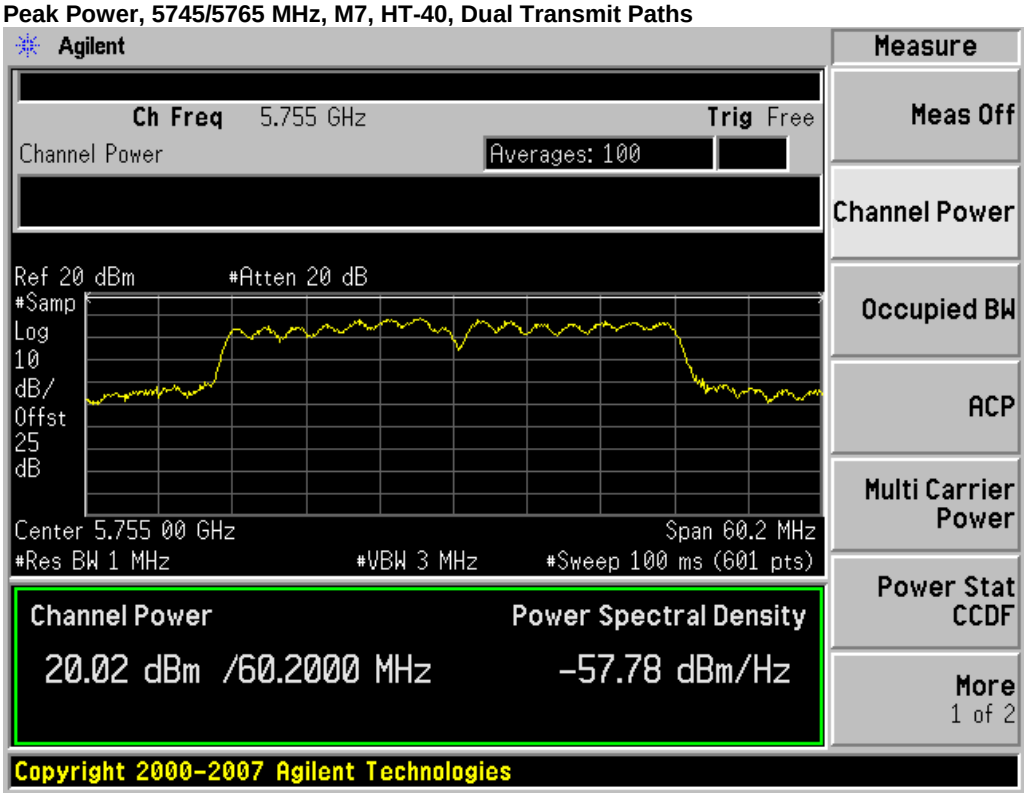
Peak Power, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



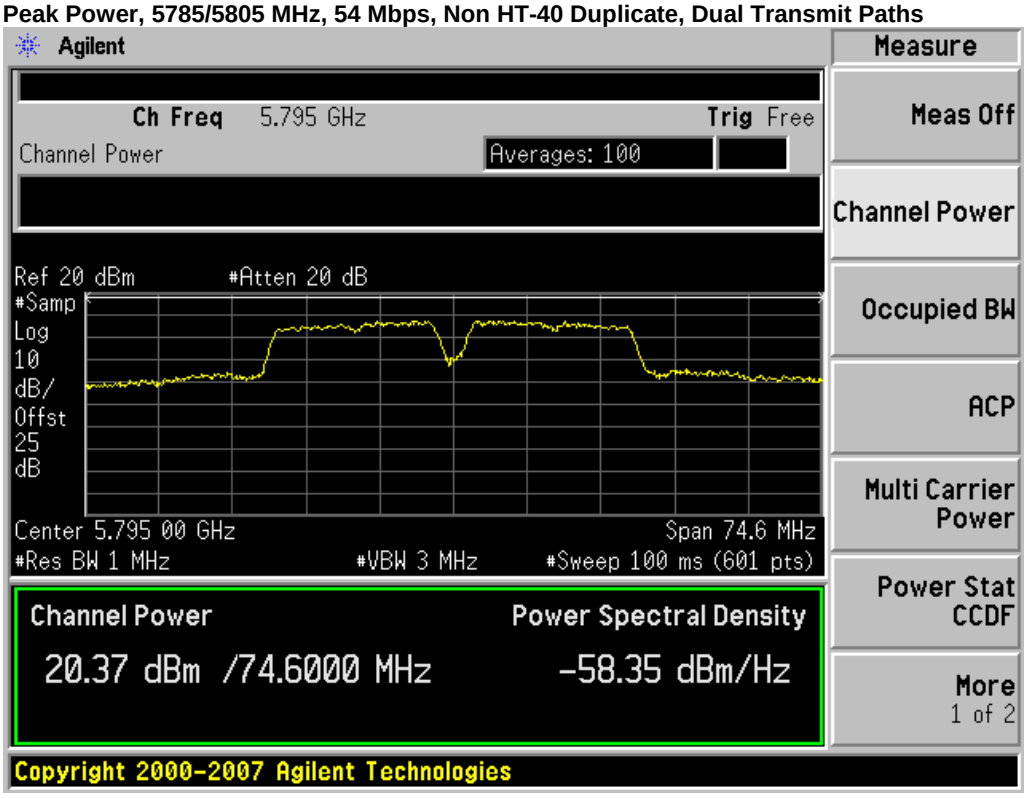
Peak Power, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



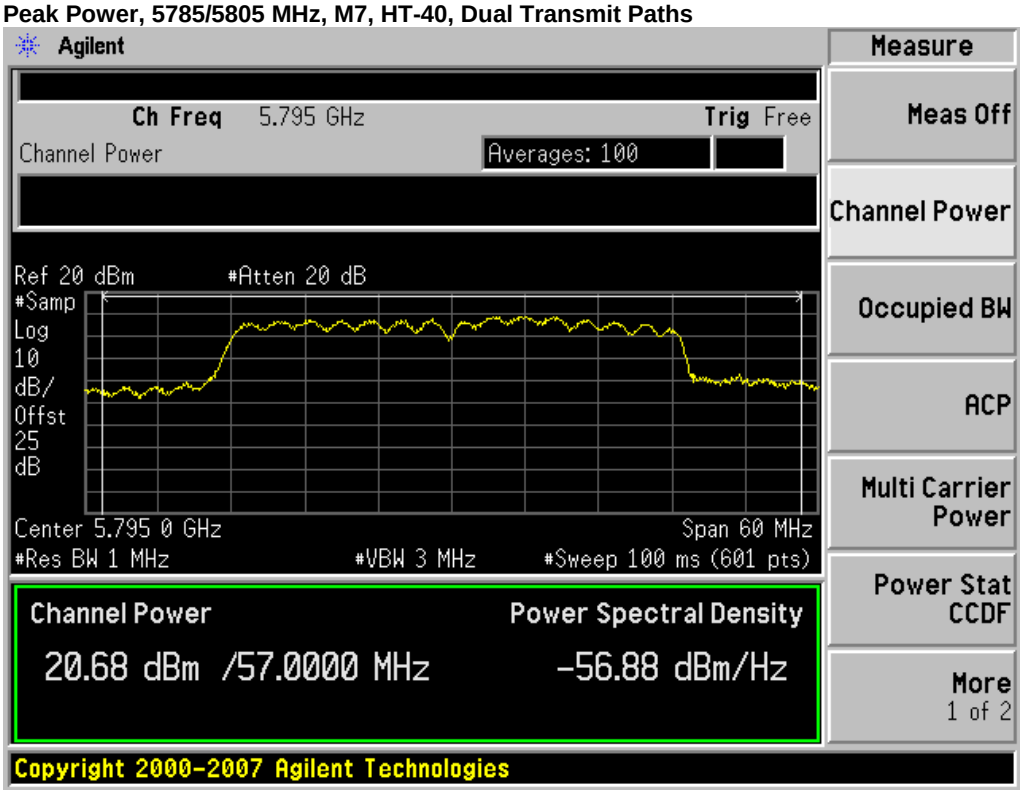
Peak Power, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths



Peak Power, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



Peak Power, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths



Power Spectral Density

15.247: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

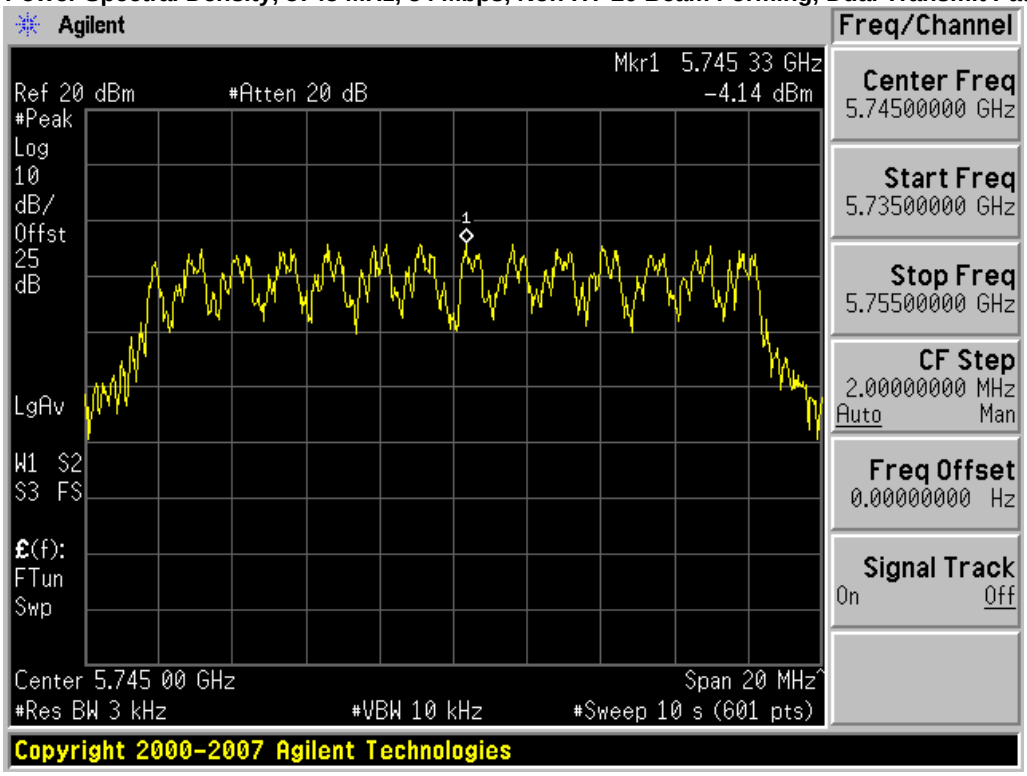
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

Center Frequency:	Frequency from table below
Span:	20 MHz
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100s
Resolution Bandwidth:	3 kHz
Video Bandwidth:	10 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak Search

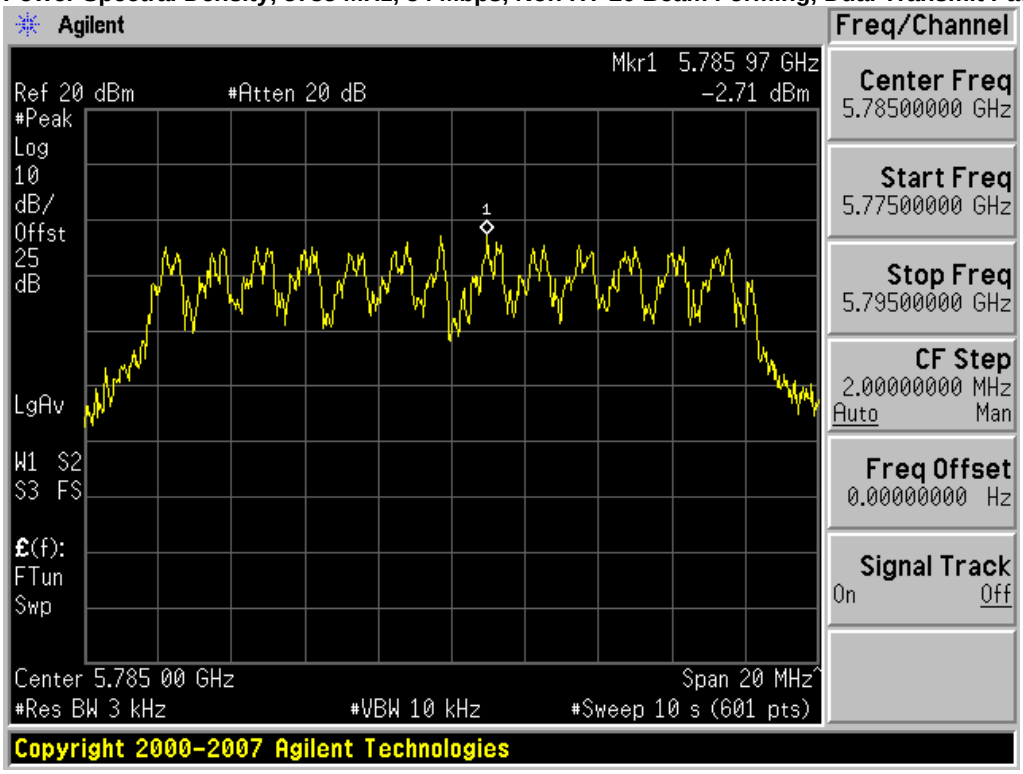
Record the Marker value.

Frequency (MHz)	Mode	Data Rate (Mbps)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
5745	Non HT-20 Beam Forming	54	**-4.1**	8	12.138
5785	Non HT-20 Beam Forming	54	**-2.7**	8	10.713
5825	Non HT-20 Beam Forming	54	**-2.2**	8	10.217
5745/5765	Non HT-40 Duplicate	54	**-5.6**	8	13.603
5745/5765	HT-40	M7	**-2.9**	8	10.929
5785/5805	Non HT-40 Duplicate	54	**-5.5**	8	13.485
5785/5805	HT-40	M7	**-3.6**	8	11.562

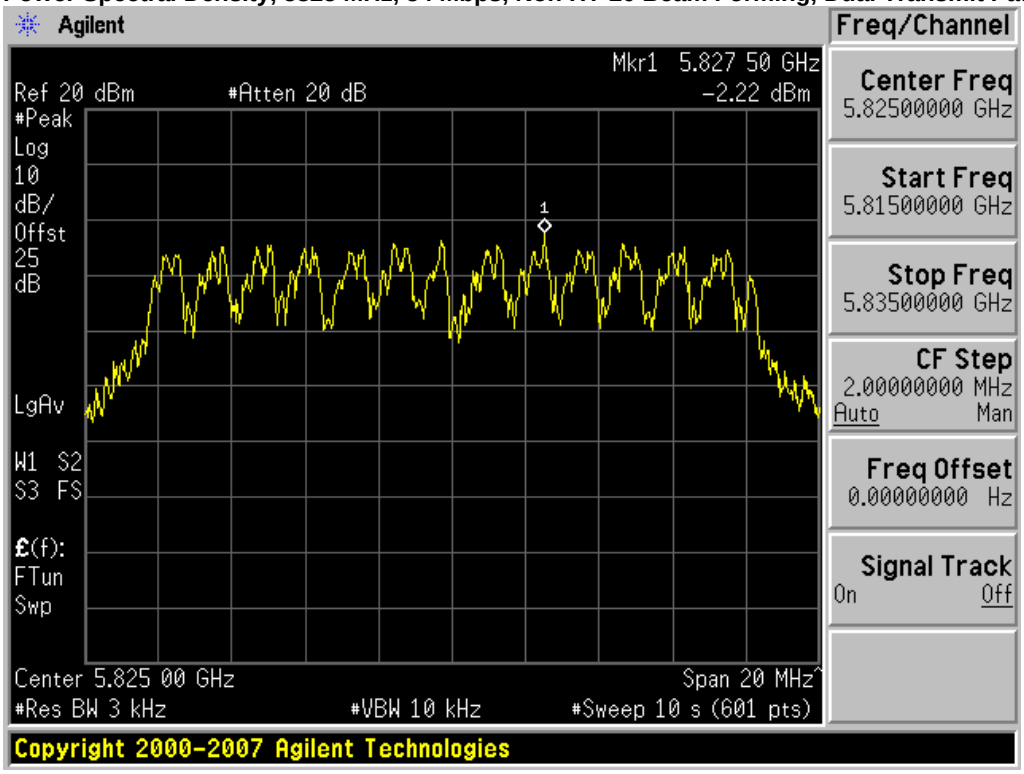
Power Spectral Density, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



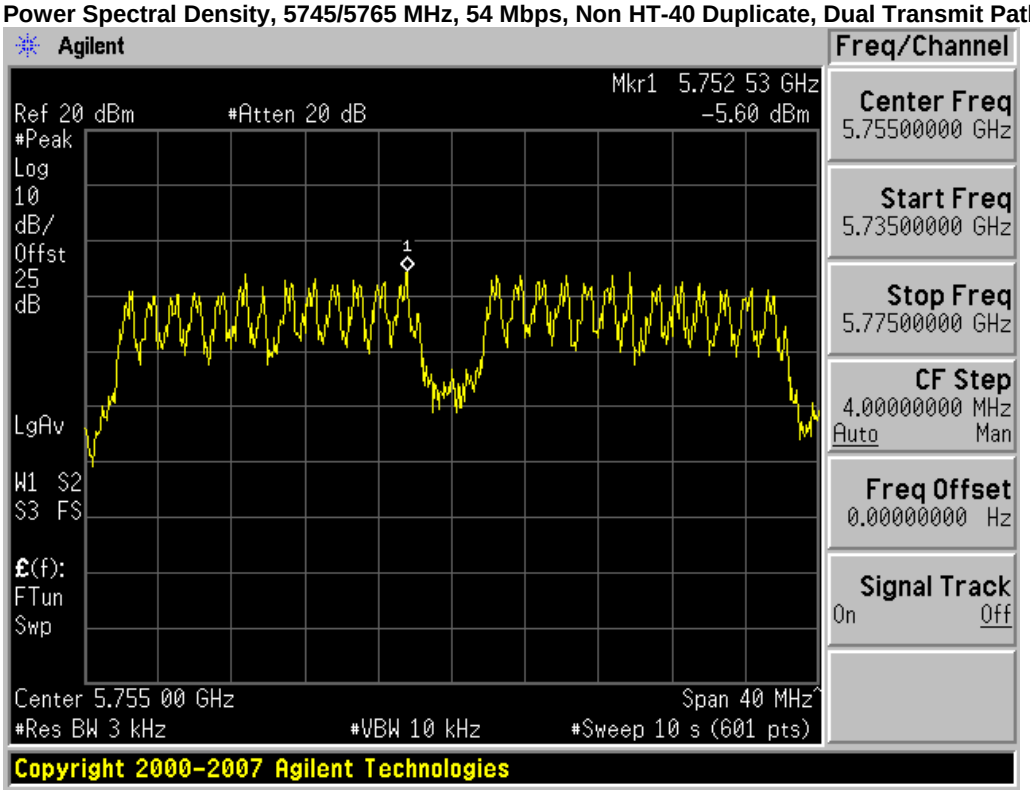
Power Spectral Density, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



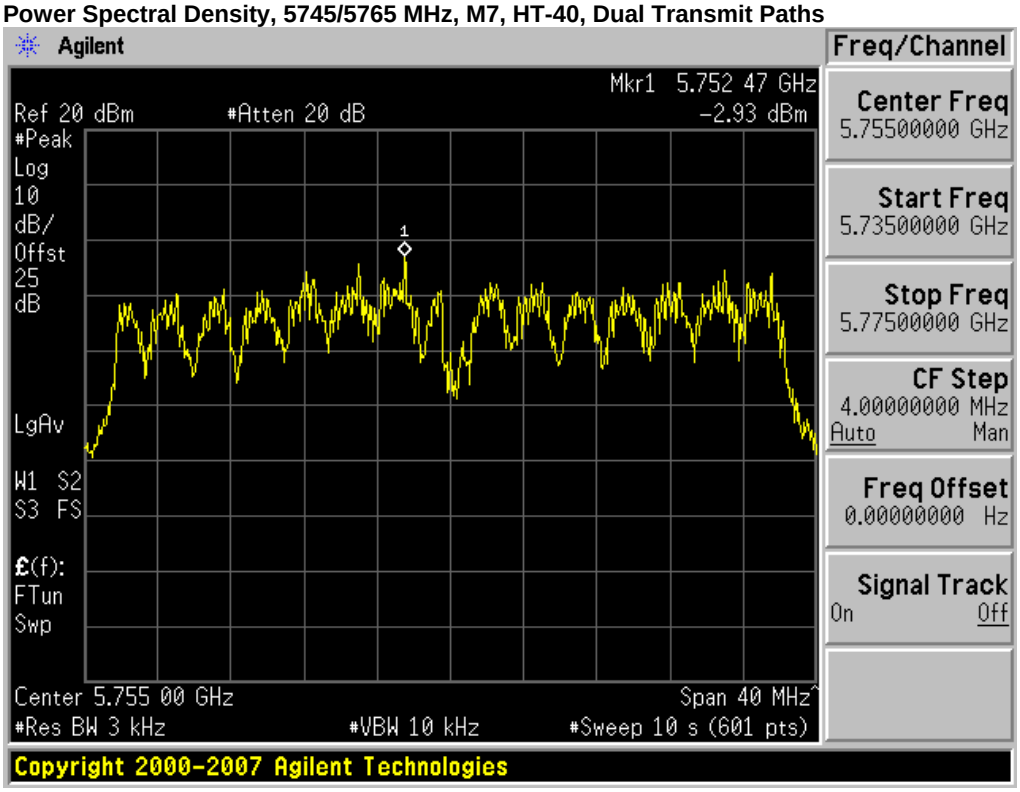
Power Spectral Density, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



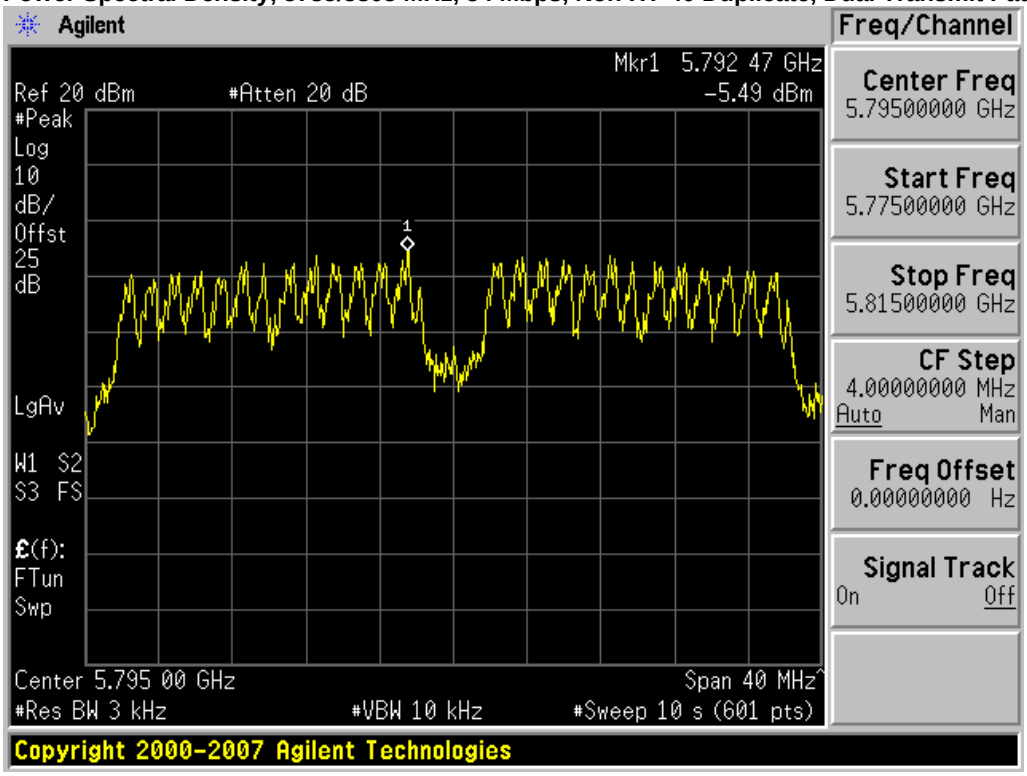
Power Spectral Density, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



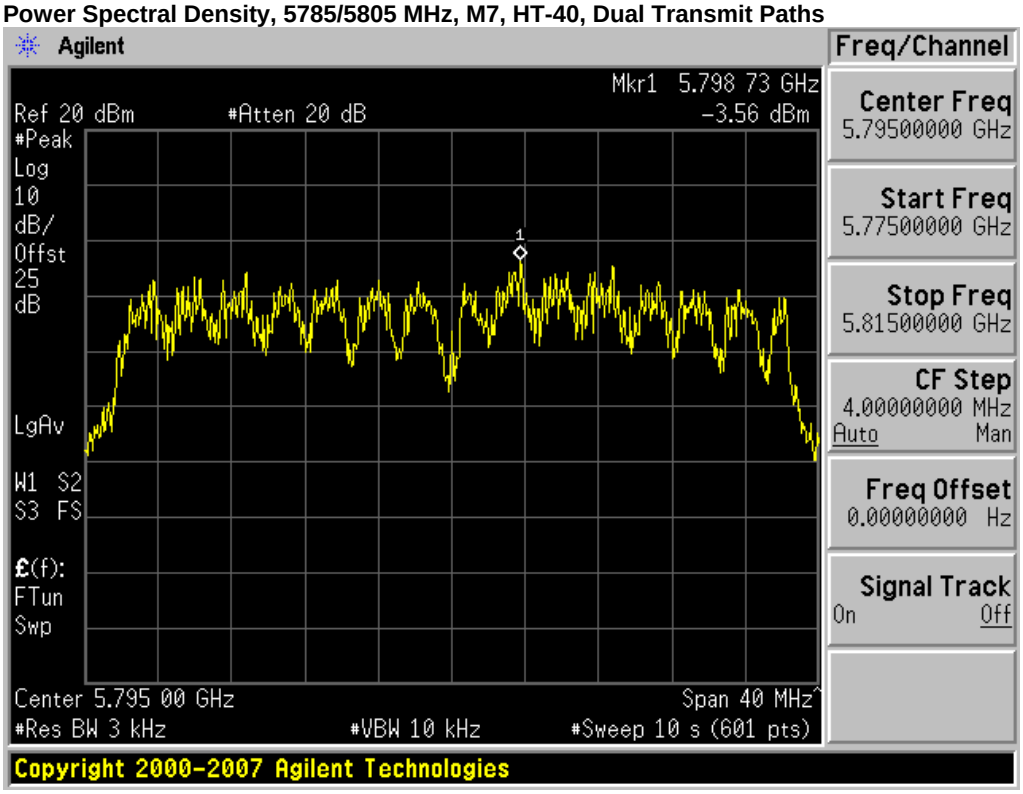
Power Spectral Density, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths



Power Spectral Density, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



Power Spectral Density, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths



Conducted Spurious Emissions

15.247: In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

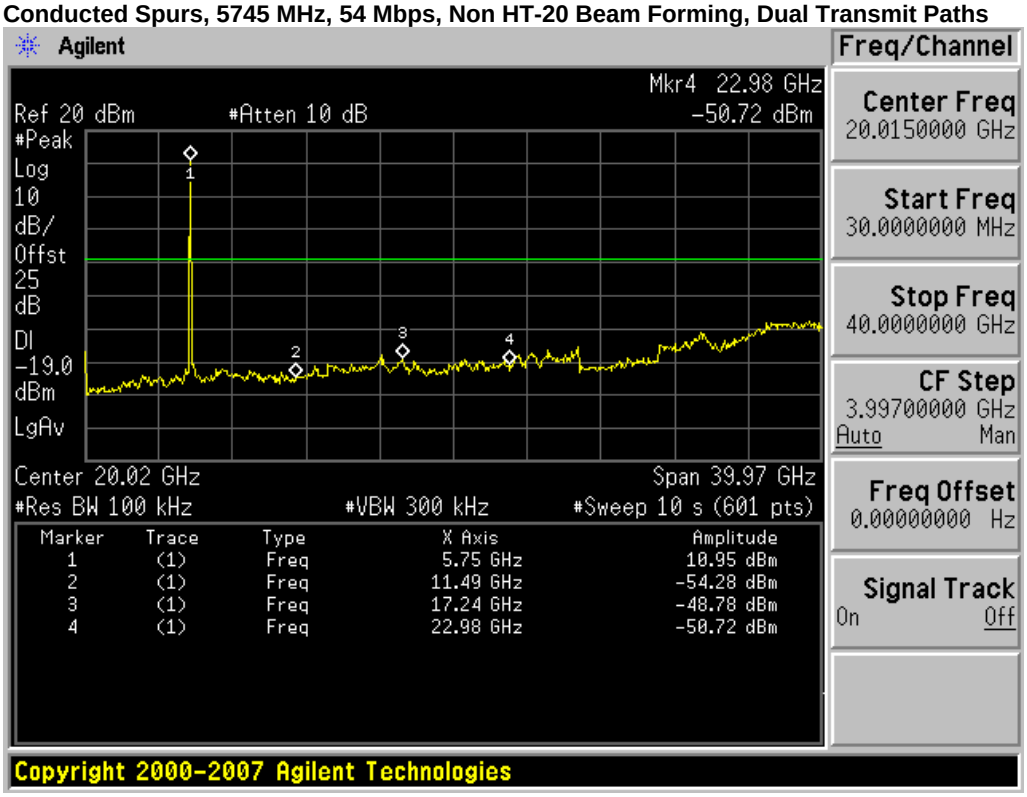
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

Span:	30 MHz-26 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak

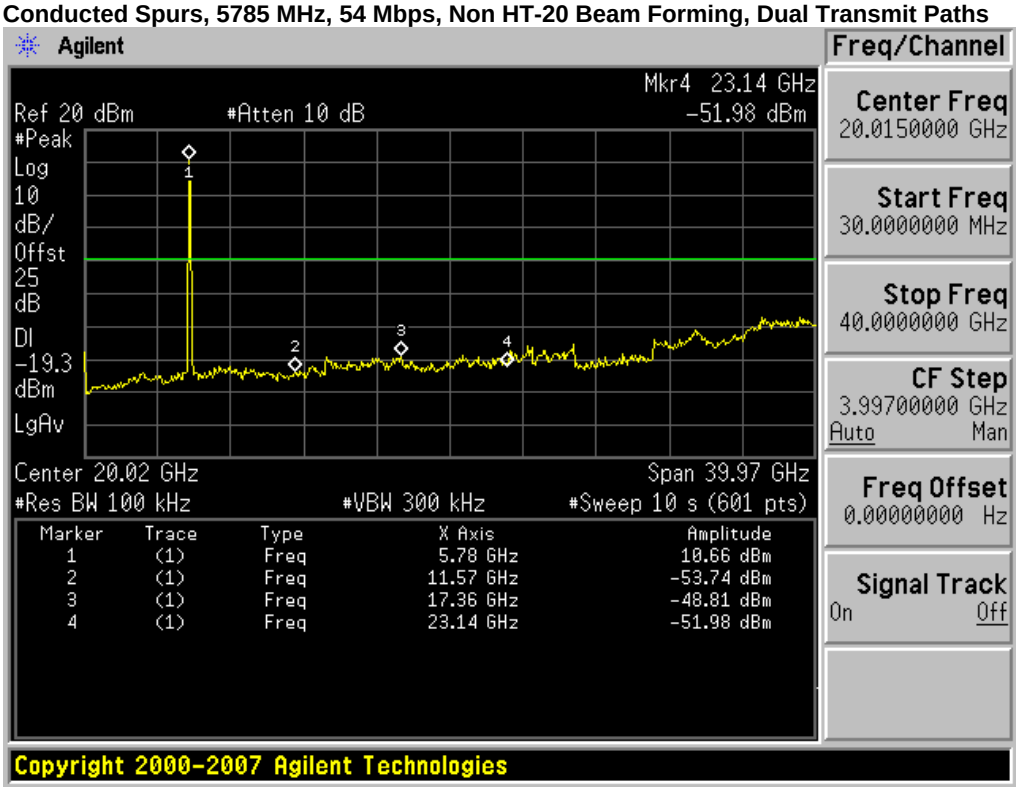
Record the marker waveform peak to spur difference

Frequency (MHz)	Mode	Data Rate (Mbps)	Conducted Spur Delta (dB)	Limit (dBc)	Margin (dB)
5745	Non HT-20 Beam Forming	54	**56.7**	30	26.7
5785	Non HT-20 Beam Forming	54	**59.5**	30	29.5
5825	Non HT-20 Beam Forming	54	**59.9**	30	29.9
5745/5765	Non HT-40 Duplicate	54	**58.7**	30	28.7
5745/5765	HT-40	M7	**56.9**	30	26.9
5785/5805	Non HT-40 Duplicate	54	**57.0**	30	27.0
5785/5805	HT-40	M7	**59.6**	30	29.6

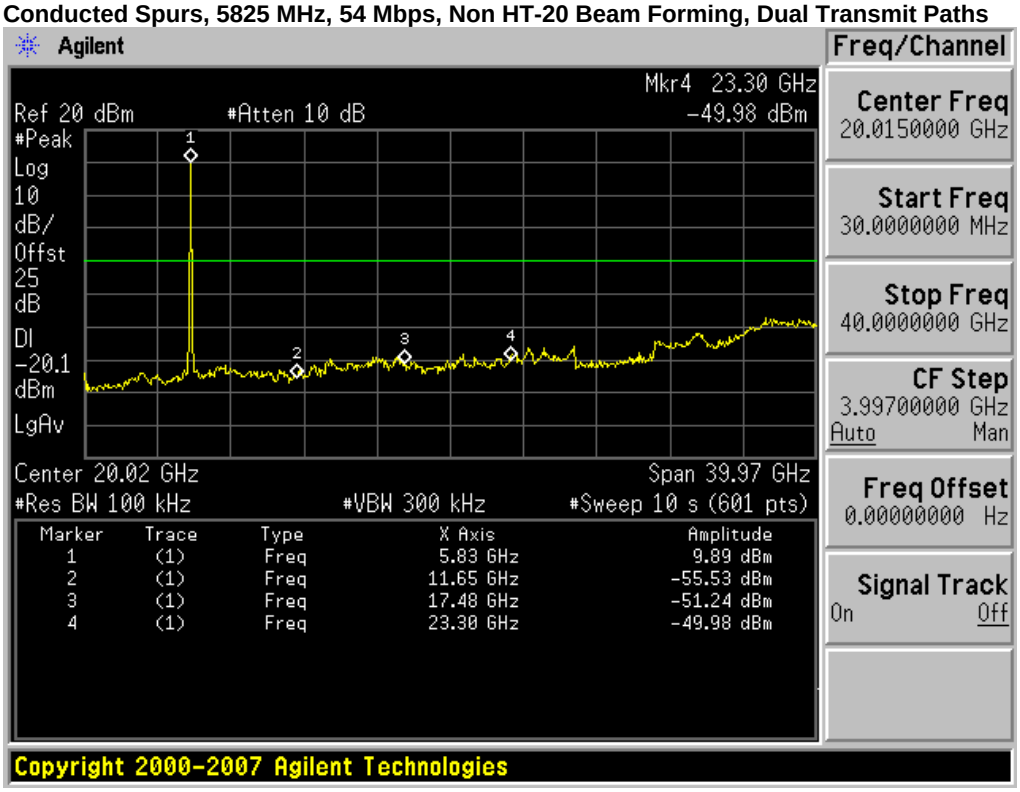
Conducted Spurs, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



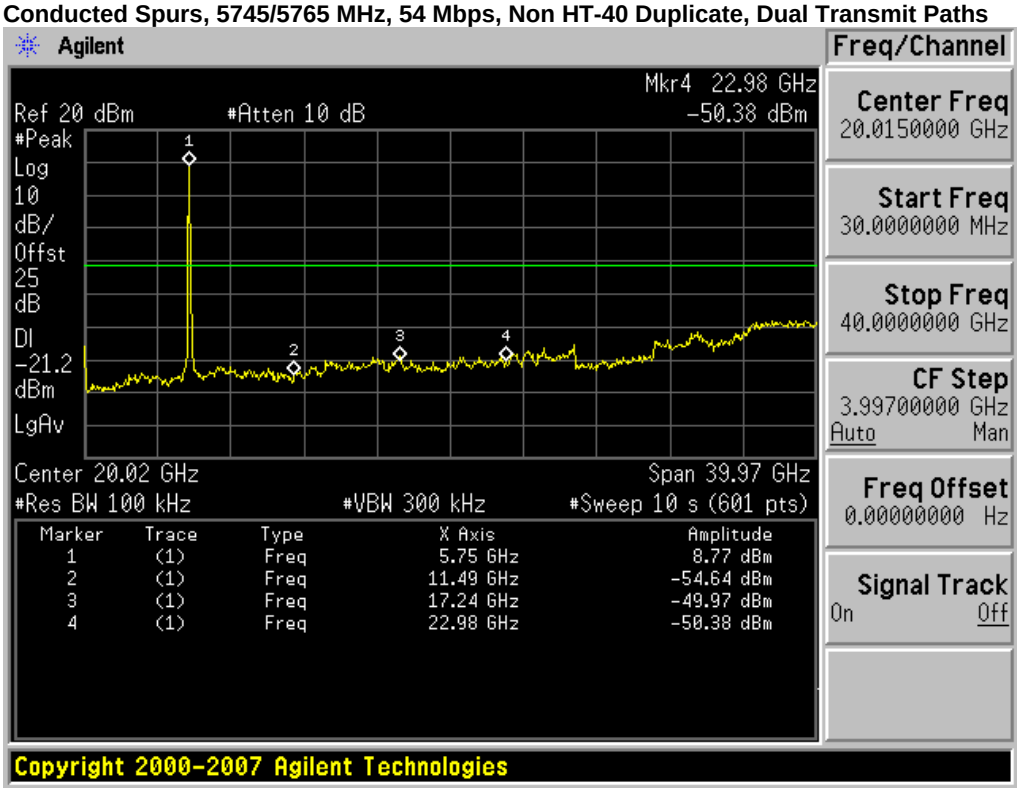
Conducted Spurs, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



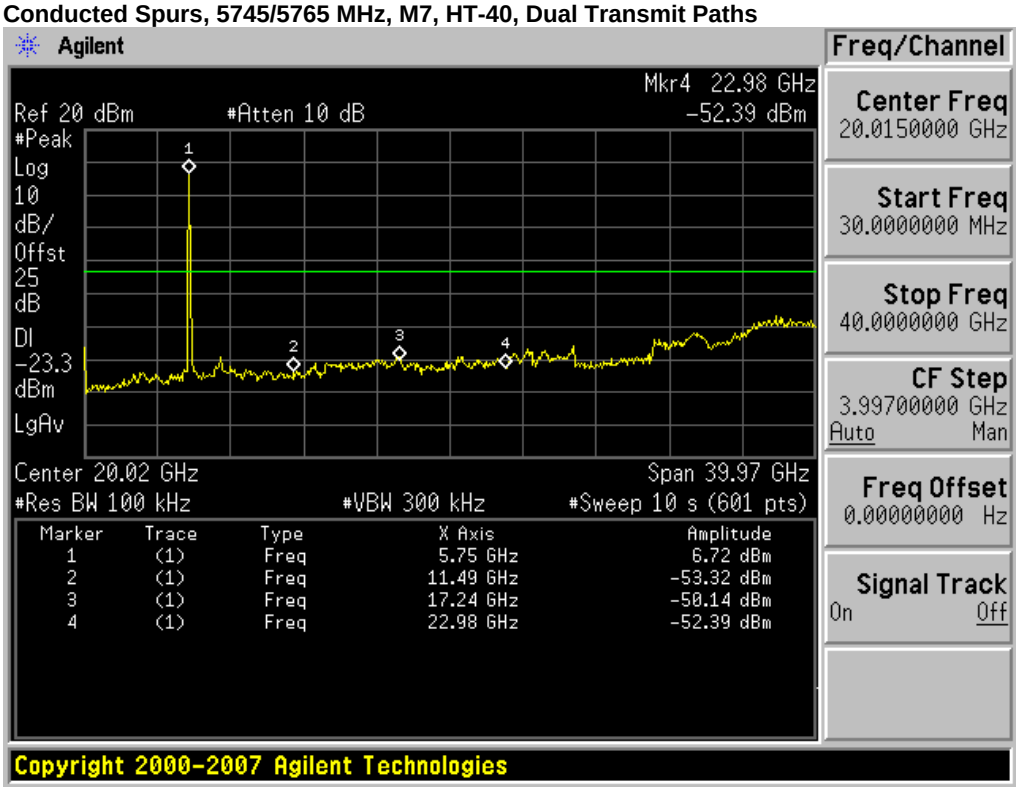
Conducted Spurs, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



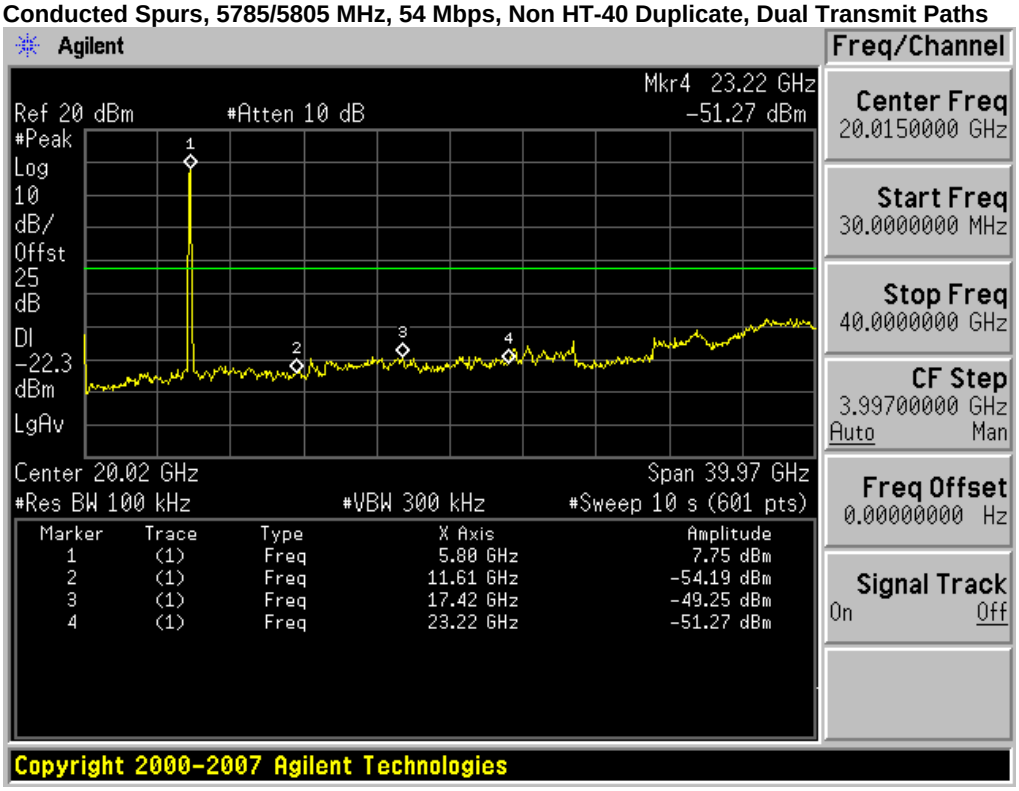
Conducted Spurs, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



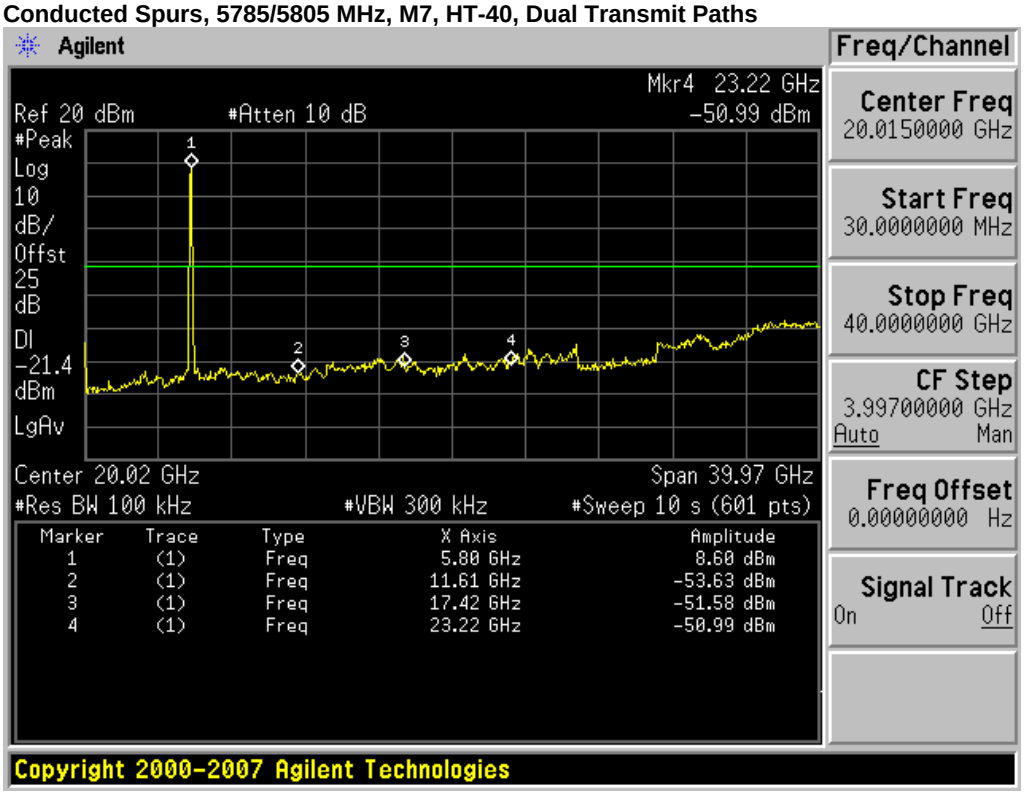
Conducted Spurs, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths

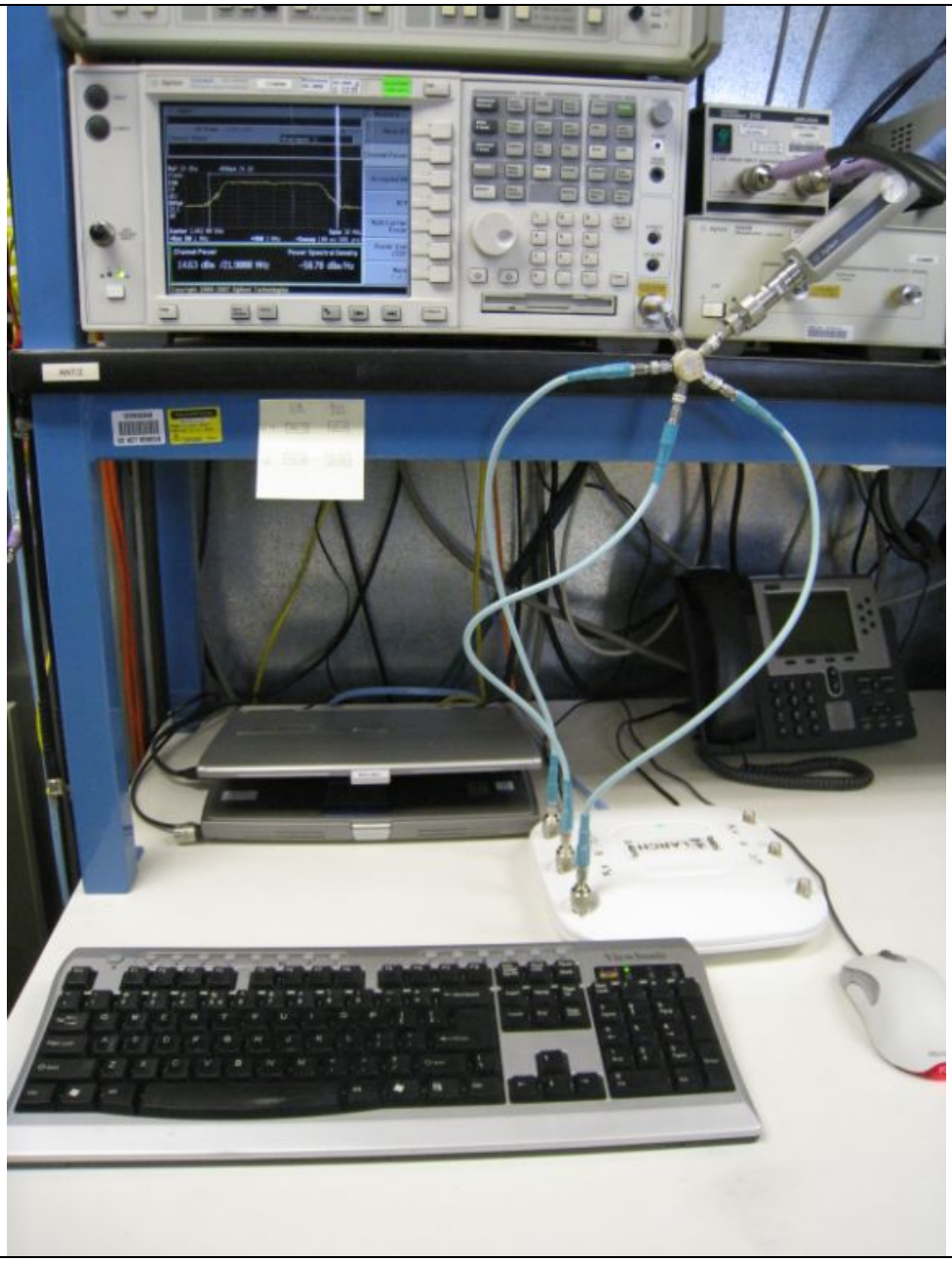


Conducted Spurs, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



Conducted Spurs, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths





Title: Conducted Test Setup

Appendix B: Emission Test Results

Testing Laboratory: Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134, USA

Radiated Bandedge

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

The following data reflects worst-case values of the AIR-ANT5160V-R (6dBi omni) and AIR-ANT-25137NP-R (7dBi patch) antennas.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	5350-5745 MHz for 5745MHz test, (Measure 5725MHz Horz & Vert) 5805-6500 MHz for 5805MHz test, (Measure 5850MHz Horz & Vert)
Reference Level:	110 dBuV
Attenuation:	20 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

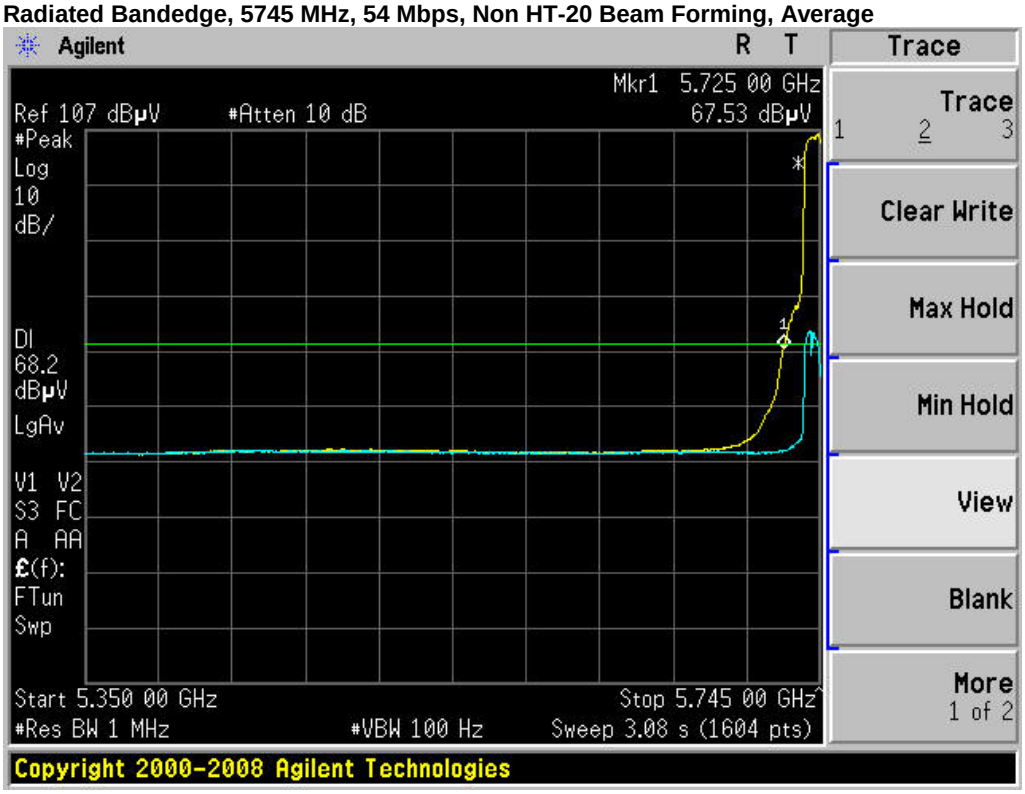
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV @3m

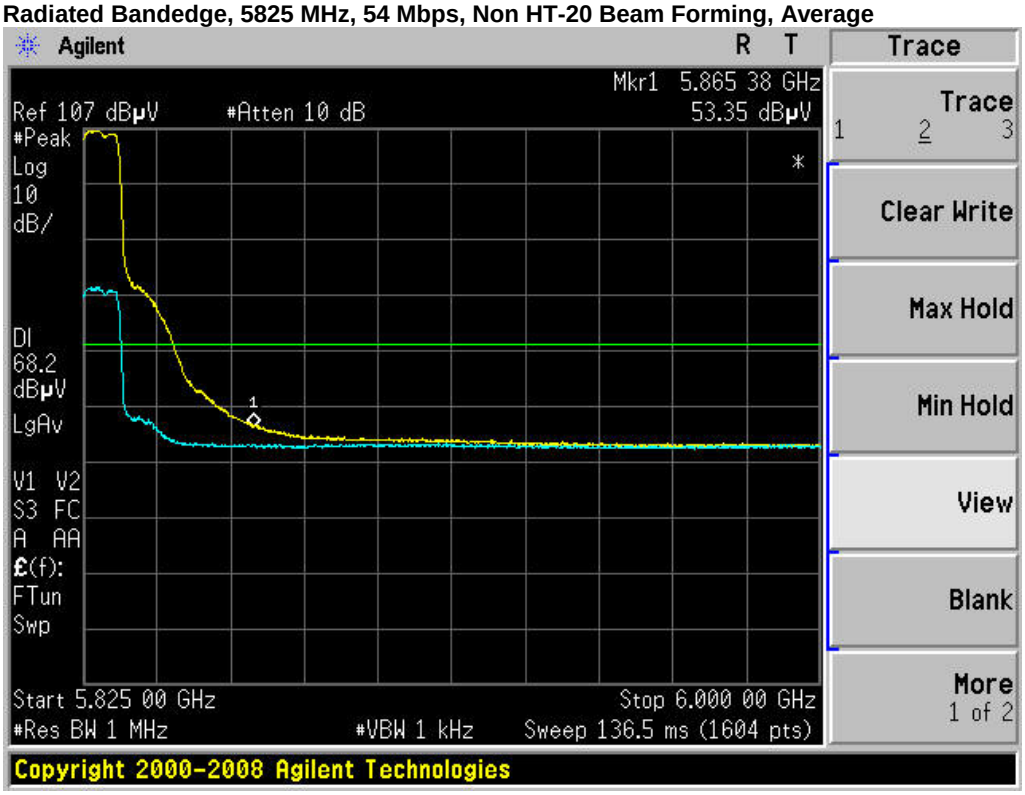
Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.

Frequency (MHz)	Mode	Data Rate (Mbps)	Radiated Band Edge Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5745	Non HT-20 Beam Forming	54	**67.5**	68	0.5
5825	Non HT-20 Beam Forming	54	**53.4**	68	14.7
5745/5765	Non HT-40, Dual Tx Path	54	**73.3**	78	4.7
5785/5805	Non HT-40, Dual Tx Path	54	**61.6**	68	6.4

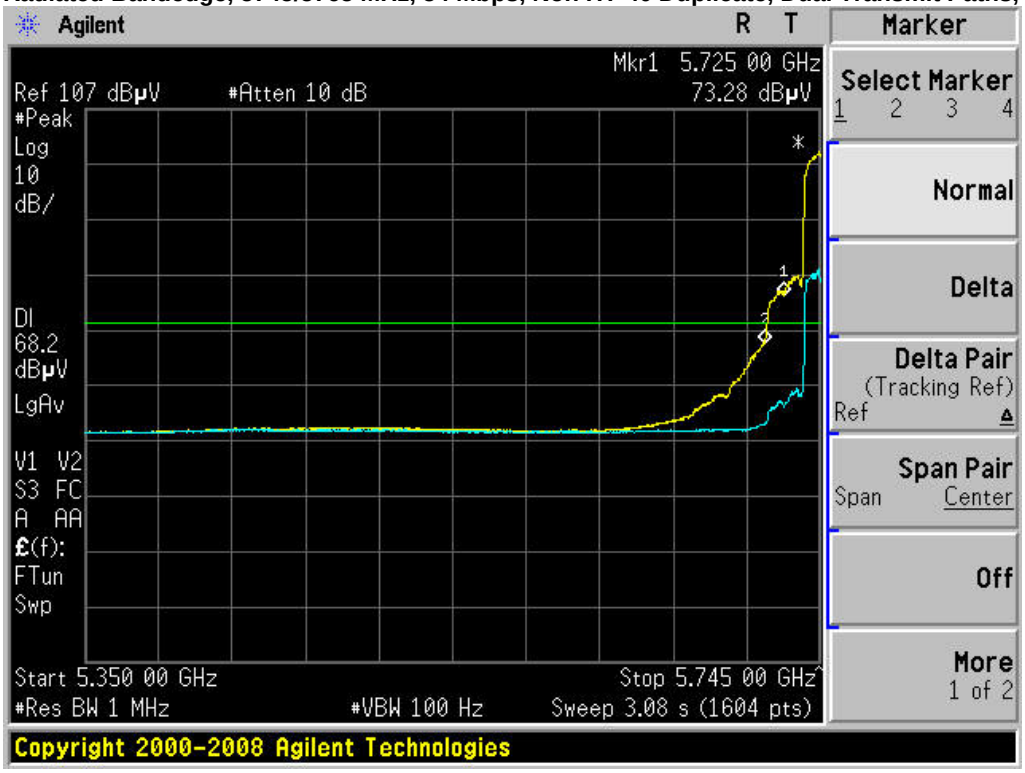
Radiated Bandedge, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Average



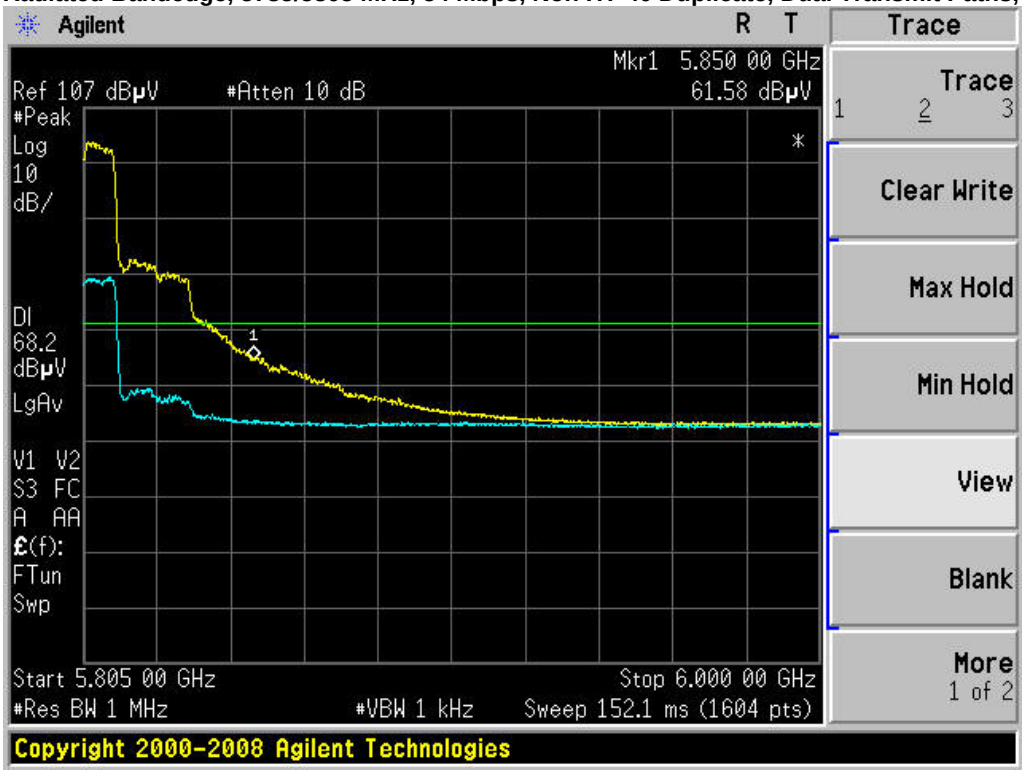
Radiated Bandedge, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Average



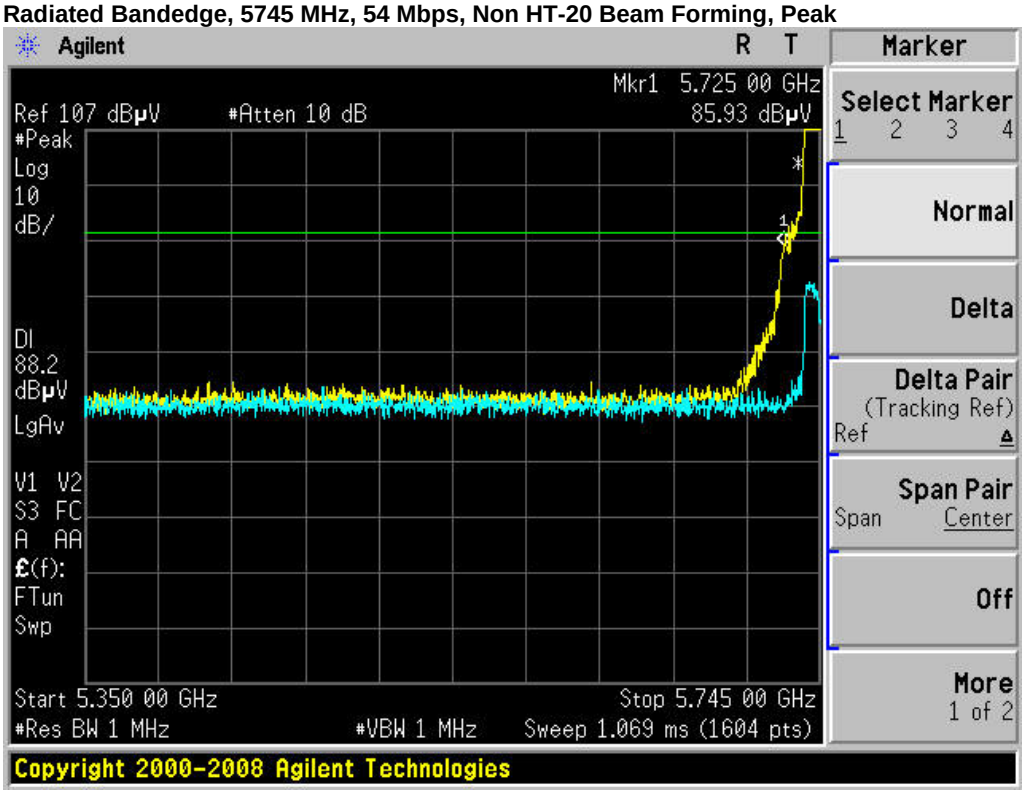
Radiated Bandedge, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average



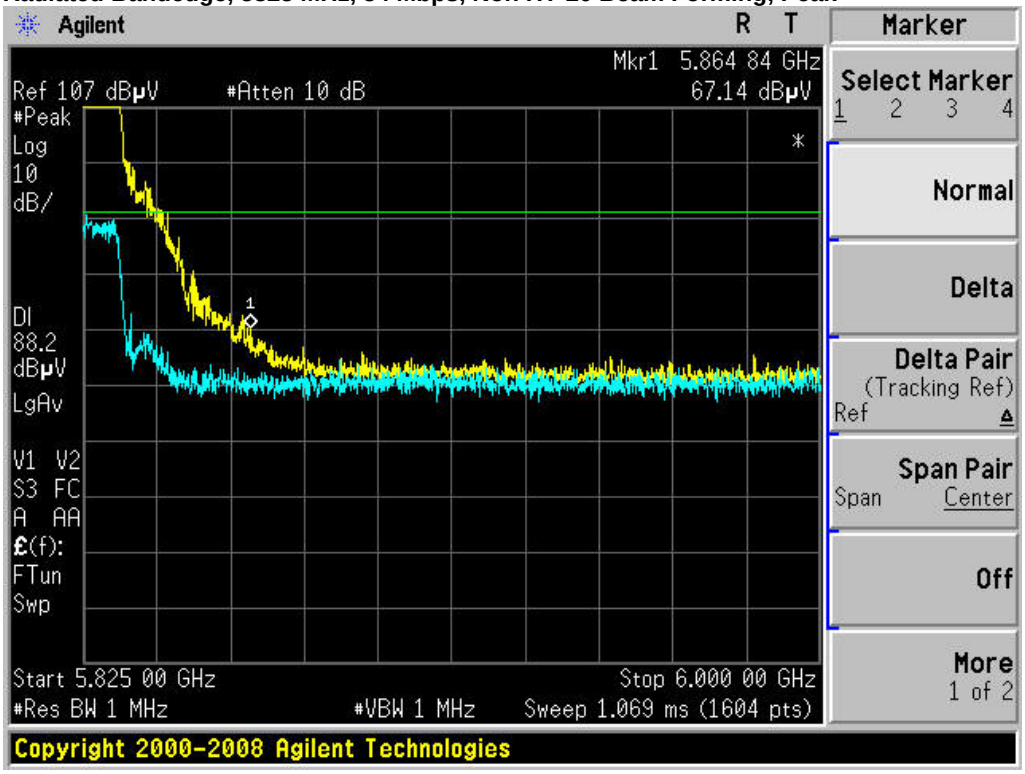
Radiated Bandedge, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average



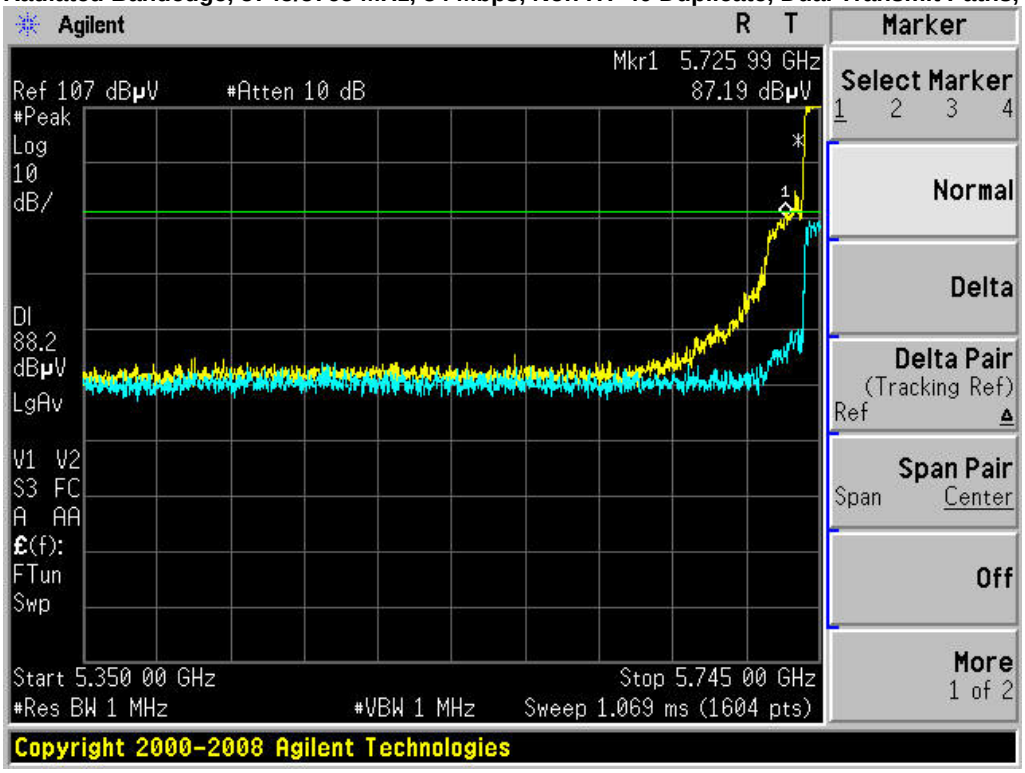
Radiated Bandedge, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak



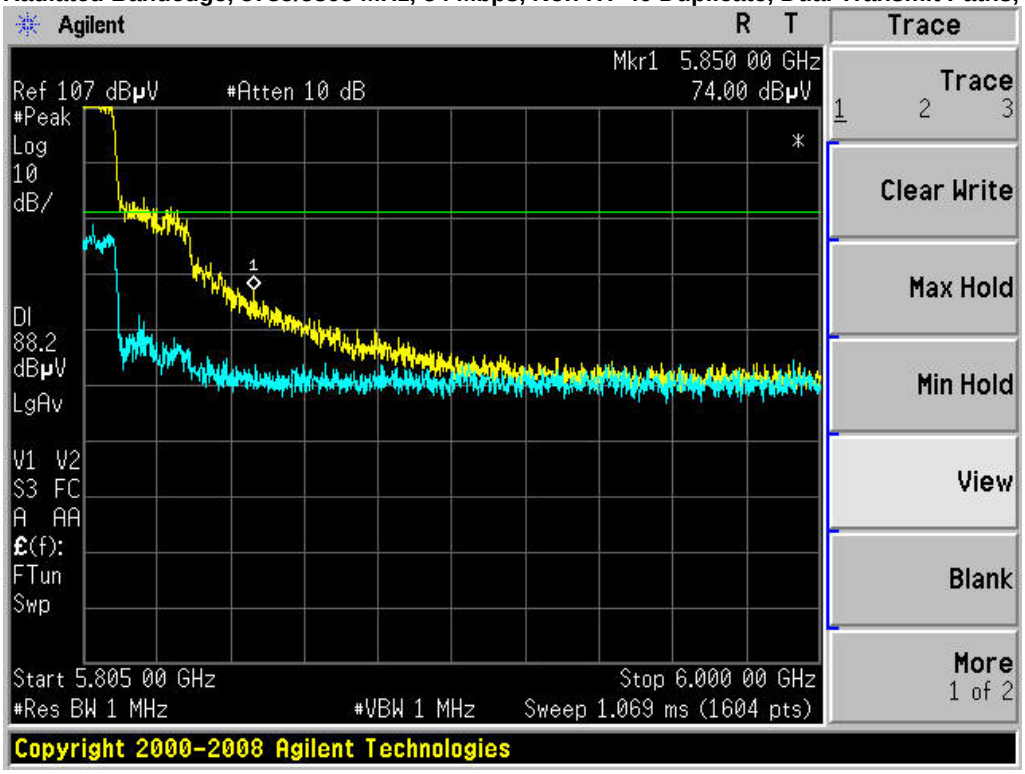
Radiated Bandedge, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak



Radiated Bandedge, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak



Radiated Bandedge, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak



Radiated Spurious Emissions

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	1GHz – 18 GHz
Reference Level:	80 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

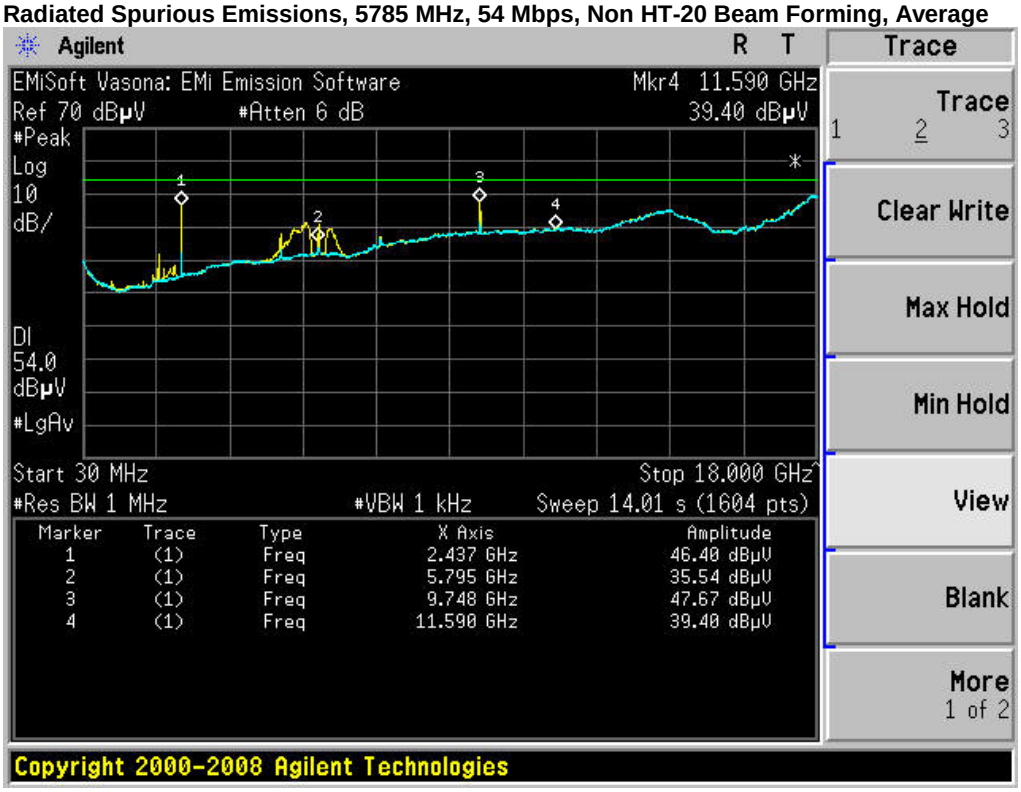
Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV @3m

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.

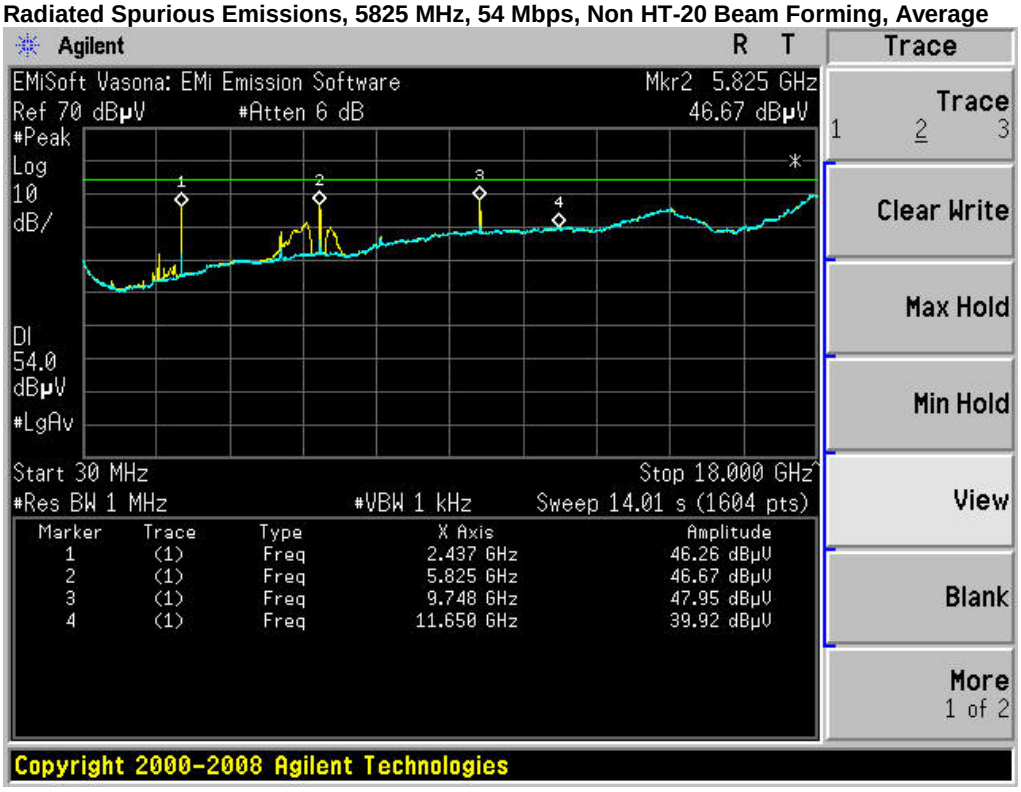
Frequency (MHz)	Mode	Data Rate (Mbps)	Spurious Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5745	Non HT-20 Beam Forming	54	**49.1**	54	4.9
5785	Non HT-20 Beam Forming	54	**48.0**	54	6.0
5825	Non HT-20 Beam Forming	54	**48.0**	54	6.1
5745/5765	Non HT-40, Dual Tx Path	54	**49.6**	54	4.4
5785/5805	Non HT-40, Dual Tx Path	54	**47.7**	54	6.3
5805/5785	Non HT-40, Dual Tx Path	54	**49.6**	54	4.4

Radiated Spurious Emissions, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Average

Radiated Spurious Emissions, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Average



Radiated Spurious Emissions, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Average

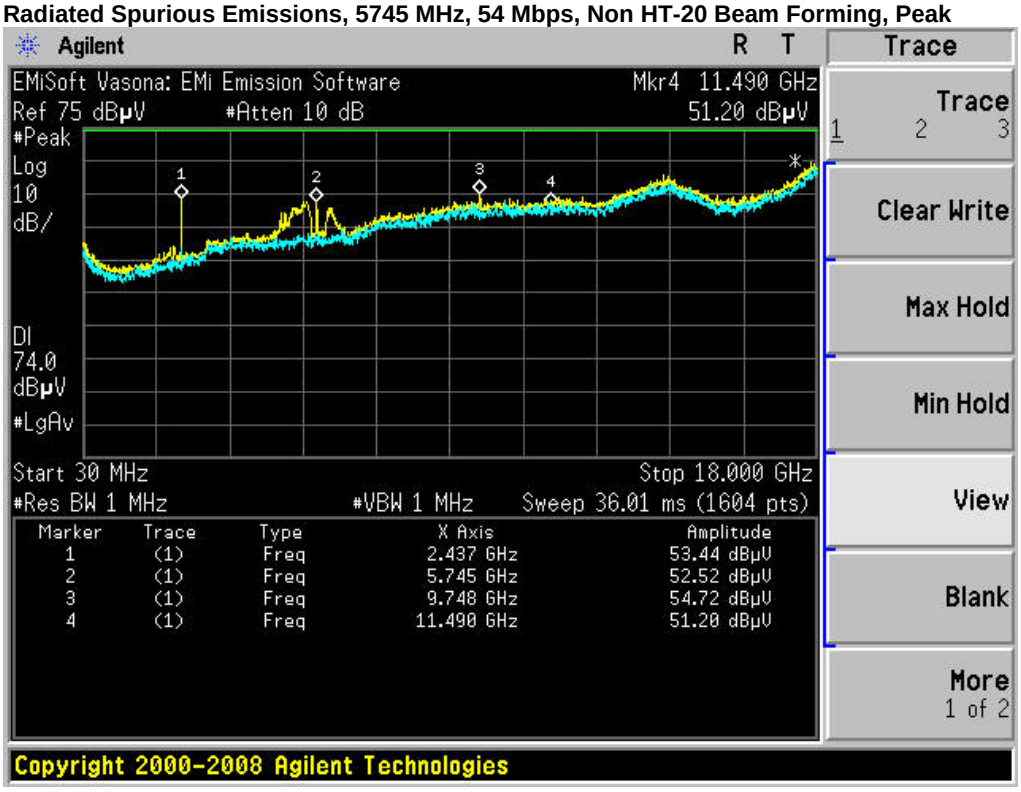


Radiated Spurious Emissions, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average

Radiated Spurious Emissions, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average

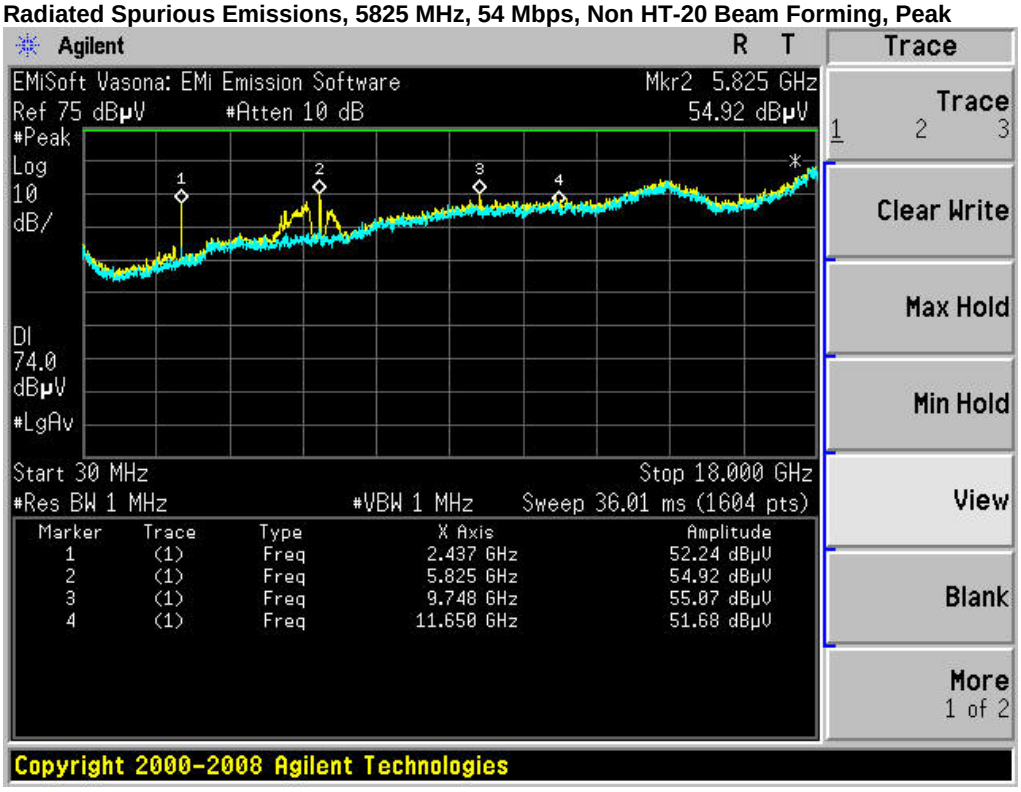
Radiated Spurious Emissions, 5805/5785 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average

Radiated Spurious Emissions, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak



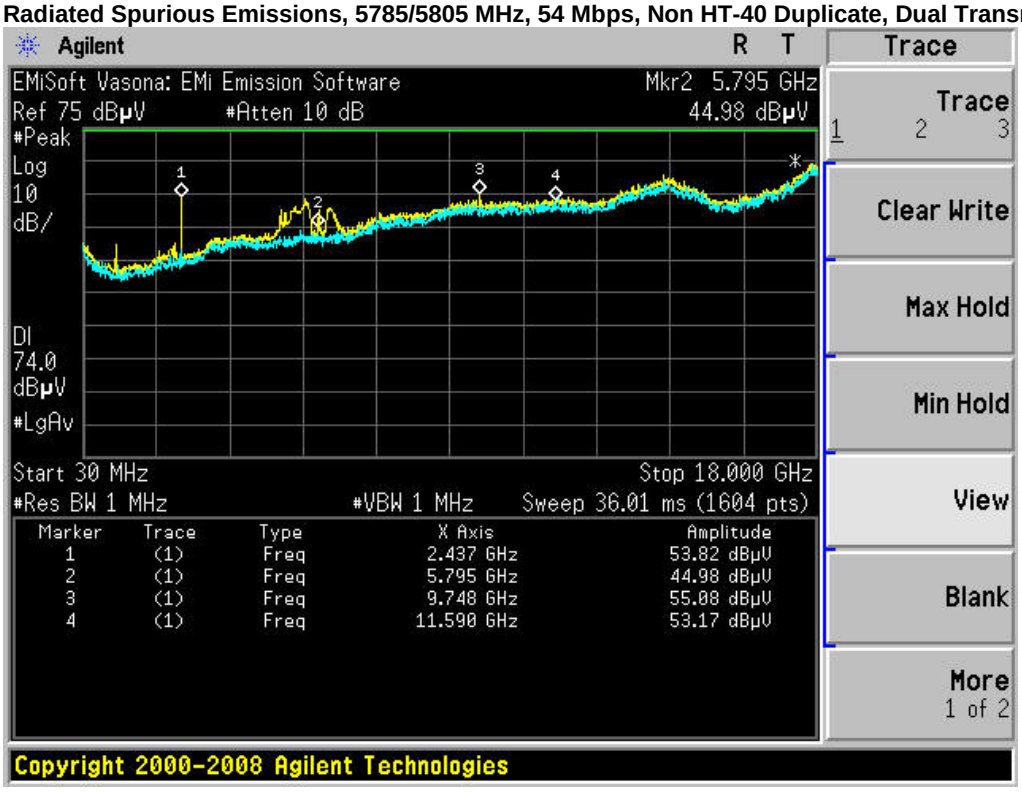
Radiated Spurious Emissions, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak

Radiated Spurious Emissions, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak

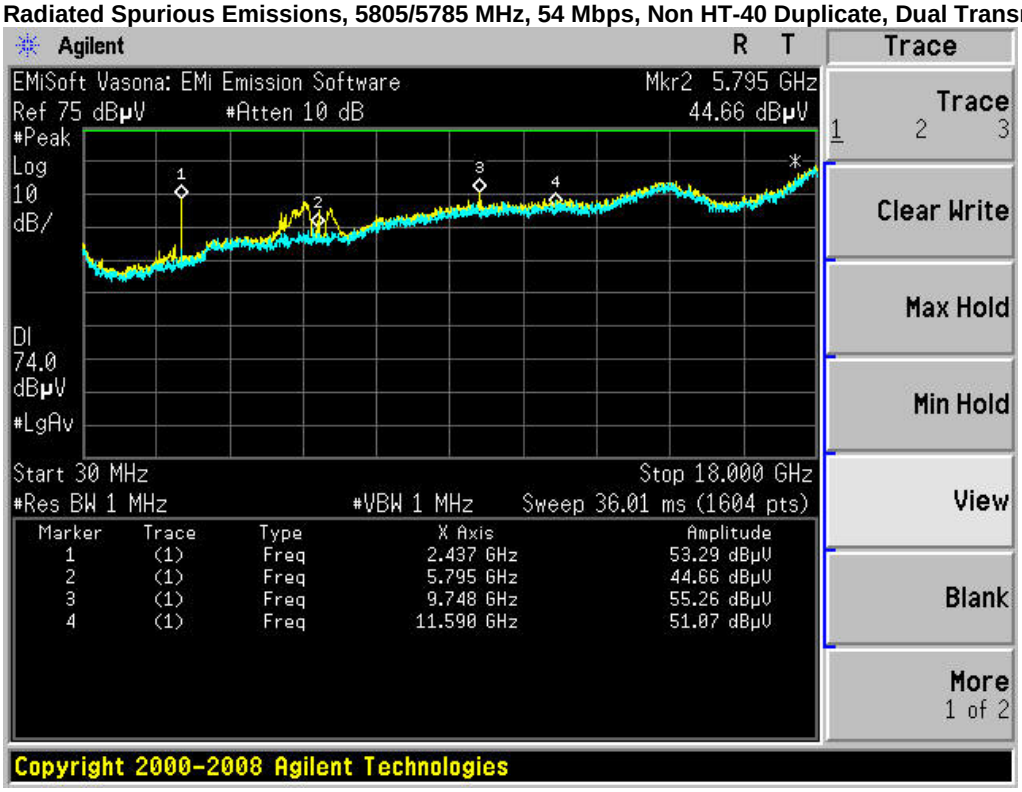


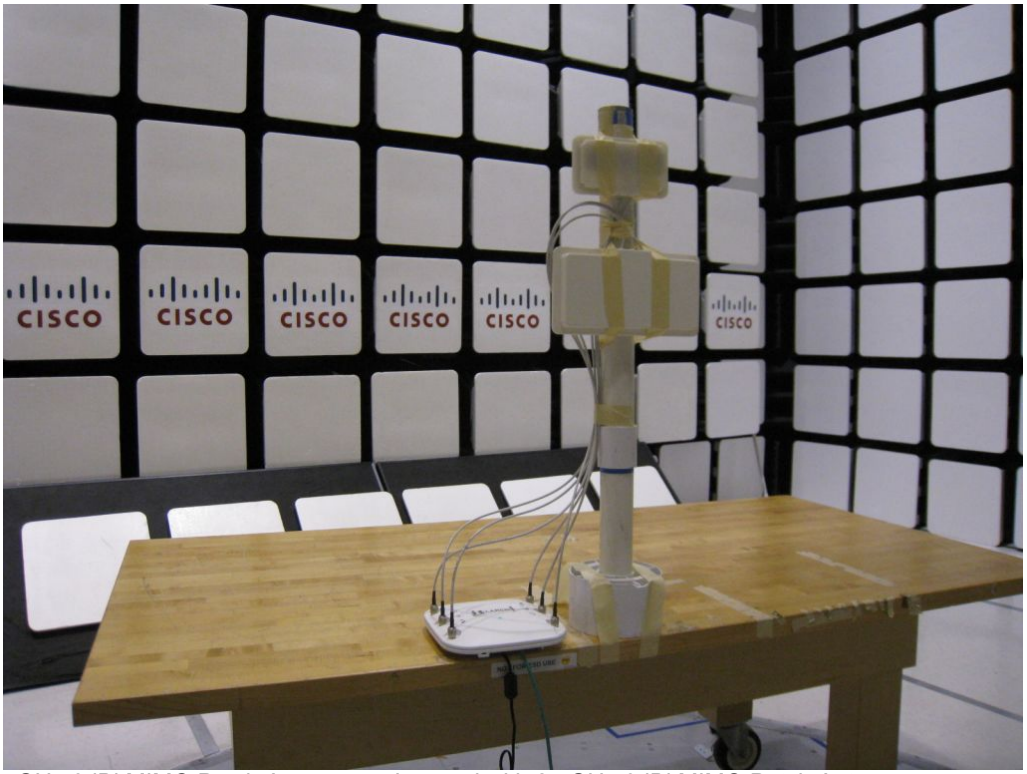
Radiated Spurious Emissions, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak

Radiated Spurious Emissions, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak

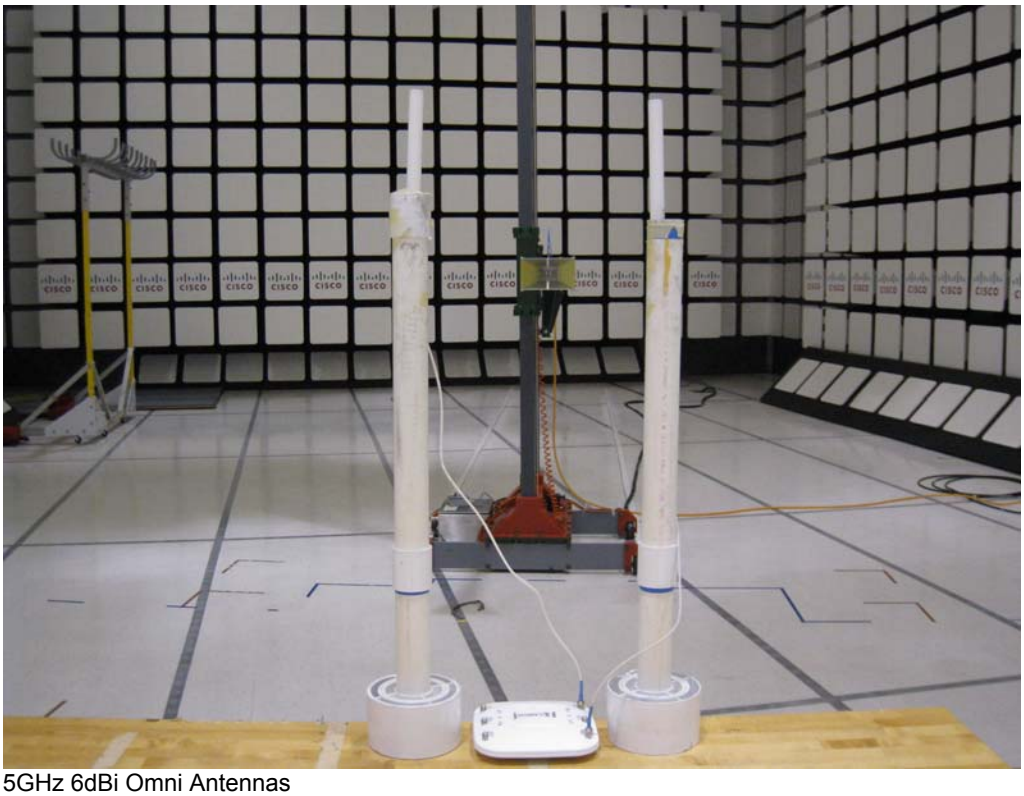


Radiated Spurious Emissions, 5805/5785 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak



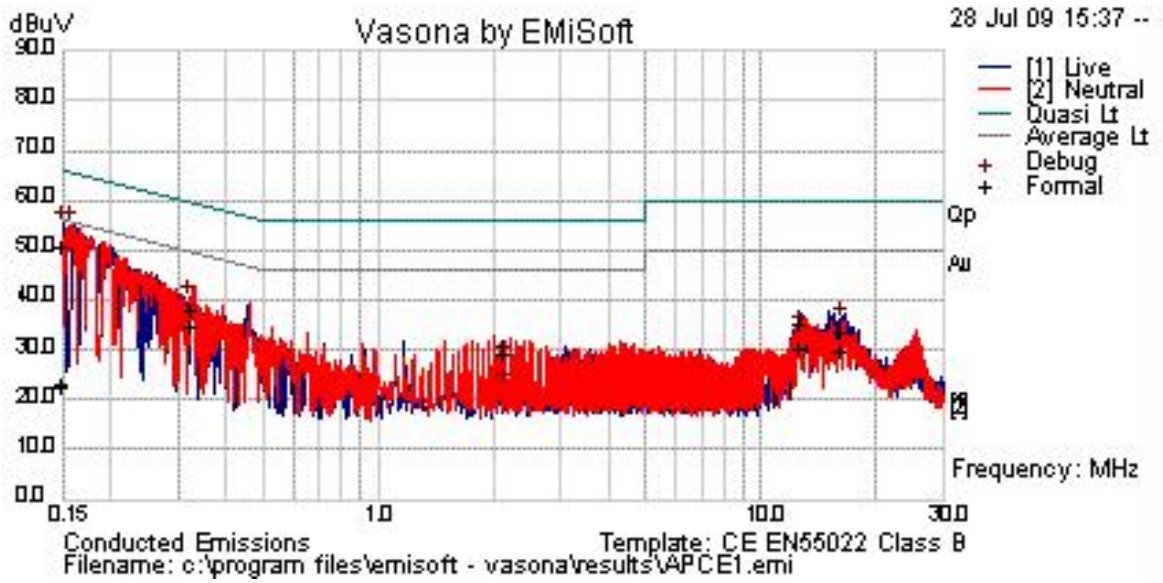


5GHz 6dBi MIMO Patch Antenna co-Located with 2.4GHz 6dBi MIMO Patch Antenna



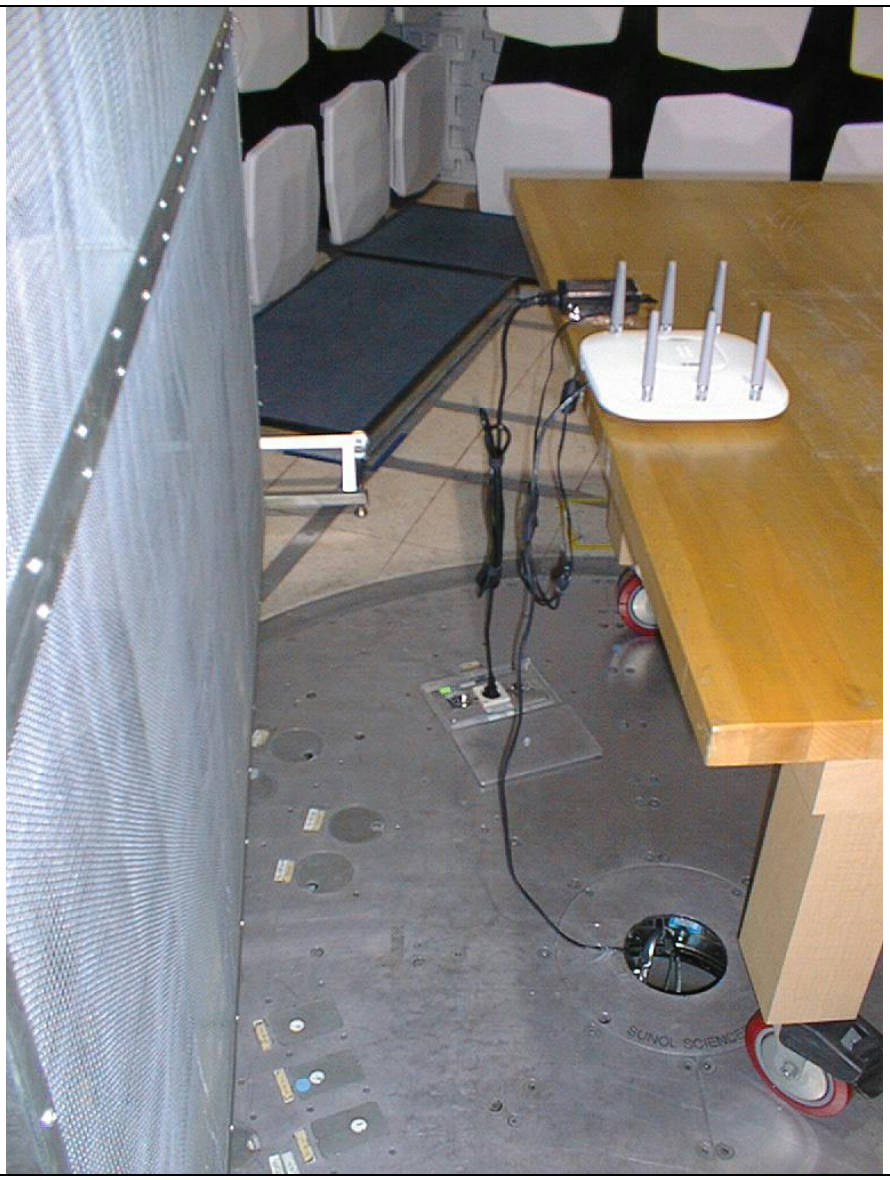
5GHz 6dBi Omni Antennas

Conducted emissions



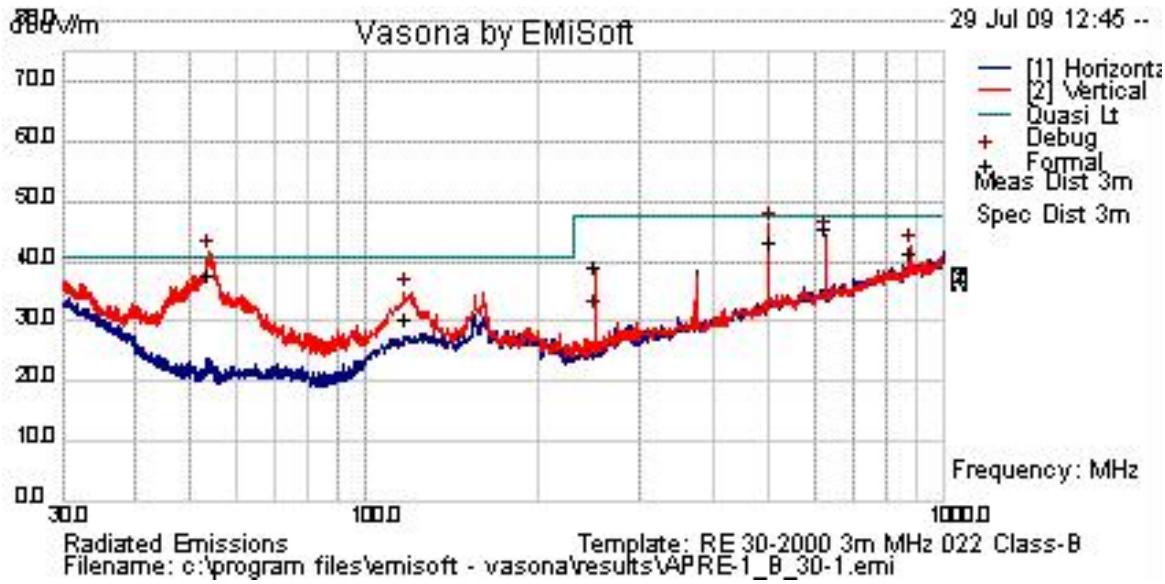
Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.15	11.3	10.1	1.8	23.2	Av	N	56	-32.8	Pass	
0.15	39	10.1	1.8	51	Qp	N	66	-15	Pass	
0.155	39	10.1	1.7	50.8	Qp	N	65.7	-14.9	Pass	
0.155	10.9	10.1	1.7	22.7	Av	N	55.7	-33	Pass	
0.326	23.7	10.2	0.8	34.7	Av	N	49.6	-14.8	Pass	
0.326	27.2	10.2	0.8	38.2	Qp	N	59.6	-21.4	Pass	
2.152	20.3	10.3	0.4	31	Qp	N	56	-25	Pass	
2.152	18.8	10.3	0.4	29.5	Av	N	46	-16.5	Pass	
12.769	19.2	10.8	0.5	30.5	Av	N	50	-19.5	Pass	
12.769	24.2	10.8	0.5	35.6	Qp	N	60	-24.4	Pass	
16.354	18	11	0.7	29.6	Av	N	50	-20.4	Pass	
16.354	22.3	11	0.7	33.9	Qp	N	60	-26.1	Pass	



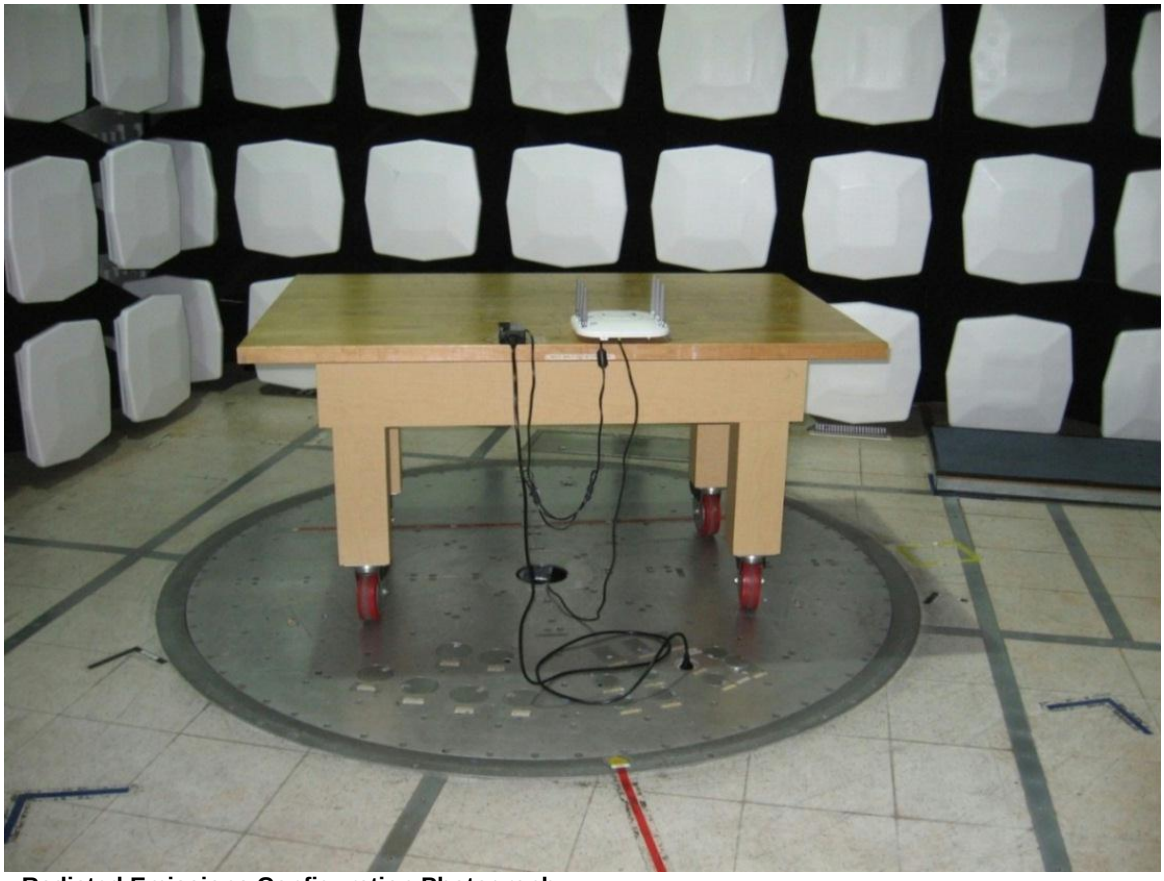
Title: Conducted Emissions Configuration Photograph

Radiated emissions



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
53.747	29.3	0.8	7.4	37.5	Qp	V	96	57	40.5	-3	Pass	
117.525	15.2	1.5	13.6	30.4	Qp	V	96	55	40.5	-10.2	Pass	
250.005	27.1	2.1	11.6	40.8	Qp	V	96	170	47.5	-6.7	Pass	
500.019	23.1	2.8	17.8	43.7	Qp	V	100	178	47.5	-3.8	Pass	
625.025	22.8	3.1	19	45	Qp	V	158	156	47.5	-2.5	Pass	
875.033	16	3.6	21.9	41.5	Qp	V	121	178	47.5	-6	Pass	



Title: Radiated Emissions Configuration Photograph

Maximum Permissible Exposure (MPE) Calculations

15.247: U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a ``general population/uncontrolled'' environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Given

E=√(30*P*G)/d and S=E^2/3770

where

E=Field Strength in Volts/meter
P=Power in Watts
G=Numeric Antenna Gain
d=Distance in meters
S=Power Density in mW/cm^2

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:

d=√((30*P*G)/(3770*S))

Changing to units of power in mW and distance in cm, using:

P(mW)=P(W)/1000 d(cm)=100*d(m)

yields

d=100*√((30*(P/1000)*G)/(3770*S))
d=0.282*√(P*G/S)

where

d=Distance in cm
P=Power in mW
G=Numerica Antenna Gain
S=Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P(mW)=10^(P(dBm)/10) G(numeric)=10^(G(dBi)/10)

yields

d=0.282*10^((P+G)/20)/√S Equation (1)

and

s=((0.282*10^((P+G)/20))/d)^2 Equation (2)

where

d=MPE distance in cm
P=Power in dBm
G=Antenna Gain in dBi
S=Power Density in mW/cm^2

Equation (1) and the measured peak power are used to calculate the MPE distance. Note that for mobile or fixed location transmitters such as an access point, the minimum separation distance is 20 cm even if the calculations indicate that the MPE distance may be less.

S=1mW/cm^2 maximum. The highest supported antenna gain is 7 dBi (10dBi with beamforming). Using the peak power levels recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

Frequency (MHz)	Bit Rate (Mbps)	Power Density (mW/cm^2)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
5745	54	1	20.4	10	**9.34**	20	10.66
5785	54	1	20.4	10	**9.34**	20	10.66
5825	54	1	20.7	10	**9.67**	20	10.33

MPE Calculations

To maintain compliance, installations will assure a separation distance of at least 20cm.

Using Equation 2, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	Bit Rate (Mbps)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Margin (mW/cm^2)
5745	54	20	20.4	10	**0.22**	1	0.78
5785	54	20	20.4	10	**0.22**	1	0.78
5825	54	20	20.7	10	**0.23**	1	0.77

Appendix C: Test Equipment/Software Used to perform the test

Equip #	Manufacturer	Model	Description	Last Cal	Next Due
CIS002119	EMC Test Systems	3115	Double Ridged Guide Horn Antenna	30-Jun-10	30-Jun-11
CIS005691	Miteq	NSP1800-25-S1	Broadband Preamplifier	12-Oct-09	12-Oct-10
CIS008195	TTE	H613-150K-50-21378	Hi Pass Filter - 150KHz cutoff	5-Jan-10	5-Jan-11
CIS045995	Fischer	F-090527-1009-2	LISN Adaptor	22-Jun-10	22-Jun-11
CIS020975	Micro-Coax	UFB311A-0-1344-520520	RF Coaxial Cable, to 18GHz, 134.4 in	25-Feb-10	25-Feb-11
CIS025662	Micro-Coax	UFB311A-1-0840-504504	RF Coaxial Cable, to 18GHz, 84 in	4-Mar-10	4-Mar-11
CIS030559	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	25-Feb-10	25-Feb-11
CIS030652	Sunol Sciences	JB1	Combination Antenna, 30MHz-2GHz	27-Jul-10	27-Jul-11
CIS031700	Micro-Tronics	BRC50705	Notch Filter, SB:5.725-5.875GHz	4-Jun-10	4-Jun-11
CIS034972	Midwest Microwave	ATT-0640-20-29M-02	Attenuator, 20dB	14-May-10	14-May-11
CIS036716	Cisco	RF Coaxial Cable-SMA	Radio Test Cable, SMA-SMA	15-Dec-09	15-Dec-10
CIS037581	ETS-Lindgren	3117	Double Ridged Waveguide Horn Antenna	22-Jun-10	22-Jun-11
CIS038371	Cisco	TH0118	Mast Mount Preamplifier Array	17-Nov-09	17-Nov-10
CIS040603	Agilent	E4440A	Spectrum Analyzer	04-Aug-10	04-Aug-11
CIS041990	MegaPhase	EM18-NKNK-320	RF 18GHz N-Type cable	25-Feb-10	25-Feb-11
COM000590	Agilent	E4448A	Spectrum Analyzer	28-May-10	28-May-11
COM000601	Agilent	E4417A	EPM-P Series Power Meter	5-Oct-09	5-Oct-10
COM000602	Agilent	E9327A	Peak and Avg Power Sensor	5-Oct-09	5-Oct-10